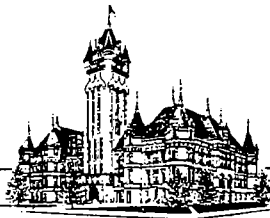


Case 8.7.2 VI

S P O K A N E C O U N T Y



UTILITIES DEPARTMENT
William R. Dobata, P.E., Director
JAMES LEGAT

A DIVISION OF THE PUBLIC WORKS DEPARTMENT
Dennis M. Scott, P.E., Director

Mr. Michael Kuntz
Site Cleanup Section
Toxics Cleanup Program
Department of Ecology
P.O. Box 47600
Olympia, WA 98504-7600

August 10, 1994
RECEIVED
AUG 11 1994
SUPERIOR REMEDIAL BRANCH

**RE: COLBERT LANDFILL - TRANSMITTAL OF INTERIM DRAFT
OPERATION AND MAINTENANCE MANUAL SECTIONS
RELATED TO AQUIFER MANAGEMENT AND WATER
QUALITY SAMPLING AND ANALYSIS**

Dear Mr. Kuntz:

This letter transmits two interim draft copies of the following sections of the Colbert Landfill Operations and Maintenance (O&M) Manual:

- Section 7 - Aquifer Management Plan
- Section 8 - Quality Assurance Project Plan
- Appendix E - Field Sampling Plan

We are sending you these draft materials in follow-up to your July 20, 1994 letter and our July 27, 1994 letter. Although we cannot finalize the O&M Manual until the NPDES criteria are finalized and additional information is provided by the construction contractor, the enclosed materials describe the methods and procedures being used on an interim basis for aquifer management and water quality sampling and analysis. We anticipate these materials will address many of the concerns raised in your July 20, 1994 letter regarding the monitoring parameters, the frequency of monitoring, the objectives of monitoring, and the type and levels of analysis. Additionally, the Aquifer Management Plan (Section 7 of the O&M Manual) addresses the hydraulic performance goals for the groundwater extraction system, which should address the questions Ecology raised concerning evaluation of the West Interception System performance.

We recognize that there are additional issues raised in your July 20, 1994 letter

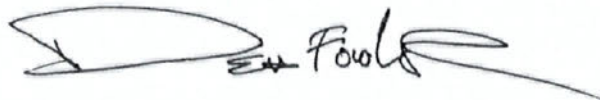
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that are not addressed in the enclosed materials. As stated in our July 27, 1994 letter, we believe that a meeting should be held between EPA, Ecology, and Spokane County as soon as possible to discuss these issues. Please contact us if you have any questions on the enclosed materials or when you are prepared to meet to discuss other project issues.

Sincerely,

A handwritten signature in black ink, appearing to read "Dean Fowler", with a long horizontal flourish extending to the right.

Dean Fowler, P.E.
Program Manager

cc: Neil Thompson/EPA
Larry Beard/Landau Associates
John Markus/Landau Associates

407- 7154
~~6235~~

RECEIVED
AUG 11 1994
SOLID WASTE REMEDIAL BRANCH

Interim Draft

**Operation and Maintenance Manual
Section 7
Aquifer Management Plan**

August 10, 1994

Prepared for

Spokane County
1026 West Broadway
Spokane, WA

Prepared by

Landau Associates, Inc.
908 North Howard, Suite 206
Spokane, WA

7.0 AQUIFER MANAGEMENT PLAN

This section presents the aquifer management plan for operation of the RA. The purpose of this section is to provide the reader with an understanding of aquifer conditions, the aquifer hydraulic controls needed to meet the project consent decree requirements, the recommended initial groundwater drawdown target values, and the recommended approach to evaluating system performance and implementing system adjustments (if needed).

7.1 Summary of Hydrogeologic Conditions and the Extent of Contamination

7.1.1 Hydrogeologic Conditions

The hydrogeologic system in the vicinity of the landfill contains four aquifers (two primary and two secondary) and three aquitards:

- The Upper Sand/Gravel Unit (Unit A) forms the Upper Sand/Gravel Aquifer when underlain by the Lacustrine Unit (Unit B), and is considered a primary aquifer.
- The Lacustrine Unit (Unit B) is the low-permeability unit that separates the Upper Sand/Gravel Unit from the Lower Sand/Gravel Unit and is referred to as the Lacustrine Aquitard. However, the Lacustrine Aquitard contains interbedded, saturated sand layers that appear to be hydraulically connected with the Upper Sand/Gravel Aquifer.
- The Lower Sand/Gravel Unit (Unit C) forms the Lower Sand/Gravel Aquifer, which is a primary aquifer, as well as the regional aquifer for the site.
- The Latah Formation (Unit D), and the Weathered Latah Subunit (Unit D₁), serve as the aquitard underlying the Lower Sand/Gravel Aquifer at most locations and (in combination) are referred to as the Latah Aquitard. However, some low-yield private wells are installed in the Latah Aquitard east of the landfill, where the Upper and Lower Sand/Gravel Aquifers are not present.
- The Basalt Unit (Unit E) forms a secondary aquifer interbedded with the Latah Aquitard and is referred to as the Basalt Aquifer.
- The Granite Unit (Unit F) serves as the lower boundary (aquitard) to the regional flow system, although some low-productivity wells are installed in the upper portion of this unit.
- The Fluvial Unit associated with the Little Spokane River forms the Fluvial (secondary) Aquifer. The Fluvial Aquifer receives recharge from the Upper Sand/Gravel Aquifer and is combined with that unit (as the Upper Aquifers) for the characterization of constituent distribution (Section 7.1.2).

Units C, D, E, and F are collectively referred to as the "Lower Aquifers" for evaluating regional groundwater flow and contaminant distribution, although the Lower Sand/Gravel Aquifer (Unit C) appears to be the only one of these units capable of sustained yield at high discharge rates.

The Upper Sand/Gravel Aquifer is unconfined, with a depth to water about 90 ft below ground surface in the Landfill vicinity. The thickness of the Upper Sand/Gravel Aquifer varies from about 8-20 ft along its north-south trending centerline and decreases as it extends toward the western bluff and eastern hills. Upper Sand/Gravel Aquifer groundwater flow is predominantly toward the south with velocities ranging from 5-7 ft/day (Landau Associates 1991). A groundwater elevation contour map for the Upper Sand/Gravel Aquifer is shown on Figure 7-1.

The Lower Sand/Gravel Aquifer is generally confined west of the landfill and unconfined from the west Landfill boundary to the east. The potentiometric surface of the Lower Sand/Gravel Aquifer is about 180 ft below ground surface, and saturated thickness varies from 0 ft east of the Landfill to over 200 ft near U.S. Highway 2. Groundwater in the Lower Sand/Gravel Aquifer flows predominantly toward the west at velocities ranging from 0.3 to 0.6 ft/day (Landau Associates 1991).

East of the Lower Sand/Gravel Aquifer, groundwater flow occurs primarily as perched groundwater at the Lower Sand/Gravel Unit interface with the underlying Latah Aquitard and within the Basalt (secondary) Aquifer, although some domestic wells are screened within the Latah and Granite Aquitards. A groundwater elevation contour map for the combined Lower Aquifers is shown on Figure 7-2.

Sections 4.1 and 4.2 of the Phase I Engineering Report (Landau Associates 1991) should be reviewed for a more thorough discussion of Project hydrogeologic conditions.

7.1.2 Constituent Distribution

The Upper Sand/Gravel Aquifer, Fluvial Aquifer, and shallow sand interbeds of the Lacustrine Aquitard are collectively referred to as the Upper Aquifers for assessing the distribution of Constituents of Concern in groundwater. The Lower Sand/Gravel Aquifer, Basalt Aquifer, Latah Aquitard, and Granite Aquitard are similarly referred to as the Lower Aquifers for constituent distribution evaluation. Figures 7-3 and 7-4 show the distribution of the

Constituents of Concern for the Upper and Lower Aquifers, respectively. These figures are based on a composite of groundwater quality data collected through June 1993 and represent the areal extent over which one or more of the Constituents of Concern were detected and the area over which one or more of the Constituents of Concern exceed the Performance Standards.

Section 4.3 of the Phase I Engineering Report (Landau Associates 1991) should be reviewed for a more thorough discussion of Project water quality conditions.

7.2 INTERCEPTION/EXTRACTION SYSTEM DESIGN

The Phase II South and West Interception Systems design included determining the spacing and discharge rates of extraction wells required to create an effective hydraulic barrier to groundwater contaminant migration in the Upper and Lower Sand/Gravel Aquifers, respectively. East Extraction System design included selecting the location and discharge rates of extraction wells to provide effective groundwater extraction for source control in the Lower Sand/Gravel and Basalt Aquifers.

7.2.1 Design Method

Because of the complex hydrogeologic conditions present in the Landfill vicinity [see Sections 4.1 and 4.2 of the Phase I Engineering Report (Landau Associates 1991) for a detailed discussion of hydrogeologic conditions], analytical analyses were considered inadequate for South and West Interception System design. MODFLOW (McDonald and Harbaugh 1988), a finite-difference numerical groundwater flow model developed by the U.S. Geological Survey, was utilized to develop separate groundwater flow models for the Upper and Lower Sand/Gravel Aquifers for interception and extraction system design.

Following development of the steady-state (nonpumping) groundwater flow models, extraction well locations were selected for the South and West Interception Systems and the East Extraction System (Figure 7-5).

The capture zones for the interception/extraction systems were estimated using a program that simulated the release of a series of particles upgradient of the extraction wells and perpendicular to the direction of groundwater flow. Each capture zone was estimated as the zone within which particles are captured by the well or wells. The well spacing and/or

pumping rates were adjusted until the zone of capture for the system was adequate and particles did not escape the system between adjacent extraction wells.

Four extraction wells were required for the South Interception System to achieve adequate plume capture, based on the capture zone analysis previously described and hydrogeologic conditions encountered during Phase II well construction (Section 7.1.1). Model-predicted system pumping rates vary from about 200 gpm to 230 gpm. The predicted capture zone for the South Interception System is shown on Figure 7-6. Estimates of individual and system flow rates are provided in Table 7-1. Estimated prepumping water elevation, minimum water elevation, well drawdown, and available drawdown are provided in Table 7-2.

Because of their interaction, contaminant capture zones for the West Interception and East Extraction Systems were evaluated as a single system. The West Interception and the East Extraction Systems each include three extraction wells, although only two of the East Extraction wells are screened in the Lower Sand/Gravel Aquifer (Extraction Well CP-E2 is screened in the Basalt Aquifer). Pumping rates required to obtain capture within the portion of the Lower Sand/Gravel Aquifer impacted by the Constituents of Concern are estimated to vary from about 400 gpm to 700 gpm for the combined flow of the West Interception and East Extraction Systems. The capture zone for the West Interception and East Extraction Systems is shown on Figure 7-7. Estimates of individual well and system pumping rates are provided in Table 7-1. Estimated prepumping water elevation, well drawdown, minimum water elevation, and available drawdown are presented in Table 7-2.

7.2.2 Regional Drawdown

Operation of the Phase II Interception and Extraction Systems will result in aquifer drawdown (i.e., lowering the water table) over a large (regional) area. This regional drawdown has the potential to impact available drawdown for private wells in the vicinity of the RA.

Drawdown for the Upper and Lower Sand/Gravel Aquifers was estimated using the MODFLOW groundwater flow models developed for interception/extraction system design. Estimated regional drawdown resulting from Phase II operation for the Upper and Lower Sand/Gravel Aquifers is presented on Figures 7-8 and 7-9, respectively. Although these estimated drawdowns provide a reasonable approximation of anticipated values, the accuracy

of these estimates may decrease as the model boundaries are approached; it is anticipated that observed drawdowns may exceed the predicted values near the model boundaries.

7.3 CONSENT DECREE REQUIREMENTS

The project consent decree specifies the groundwater quality criteria that must be achieved during operation, and to demonstrate completion, of the RA. The consent decree also contains criteria identifying the concentrations at which the need for adjustment or modification of the RA interception/extraction system must be evaluated, as well as providing for reduction in operation requirements if certain conditions are achieved for a specified period of time. These criteria, developed for the Constituents of Concern, are concentration-based and include the Project Performance Standards, Evaluation Criteria, and Operational and Adjustment Control Criteria, defined below.

7.3.1 Consent Decree Groundwater Criteria

The Performance Standards are the health-based criteria that must be achieved throughout the aquifers to demonstrate that the RA is complete. The Evaluation Criteria are the same as the Performance Standards, except that the criteria for PCE and methylene chloride are higher to address the difficulty in quantifying these constituents at their Performance Standard concentrations. The Evaluation Criteria are the criteria specified in the consent decree as the direct or indirect bases for evaluating performance of the RA interception/extraction system during operation. The Performance Standards and Evaluation Criteria are shown in Table 7-3.

The project consent decree specifies that Operational and Adjustment Control Criteria be developed, and once developed, requires that the South and West interception systems be adjusted or modified if these criteria are not achieved in selected downgradient compliance monitoring wells. If Operational Control Criteria are exceeded in compliance monitoring wells, Spokane County must evaluate operation of the associated (South or West) Interception System, and if appropriate, adjust system operation (e.g., modify pumping rates). If Adjustment Control Criteria are exceeded (after system adjustment, based on exceedance of Operational Control Criteria), interception system modification is required (e.g., installation of new extraction wells).

The Operational and Adjustment Control Criteria will be developed once baseline groundwater quality concentrations have been determined for downgradient compliance monitoring wells from the first 2 years of groundwater quality data. The Operational Control Criteria will be equivalent to the lesser of 30 percent of the Evaluation Criteria, or 15 percent of the Evaluation Criteria plus the baseline groundwater concentration for TCA and DCA (whichever is less). The Adjustment Control Criteria will be equivalent to 65 percent of the Evaluation Criteria, or 50 percent of the Evaluation Criteria plus the baseline groundwater concentration for TCA, DCE, DCA, and TCE (whichever is least). Prior to development of Operation and Adjustment Control criteria, adjustment or modification of the interception/extraction system is required if the Evaluation Criteria are exceeded in any of the downgradient compliance monitoring wells.

Operational and Adjustment Control criteria will be applied to average concentrations for compliance monitoring wells selected by EPA and Ecology as performance monitoring wells; system operation must also be evaluated if individual wells demonstrate concentration trends that suggest a long-term exceedance of Adjustment Control Criteria or if the Evaluation Criteria are exceeded.

For the purposes of this O&M manual, the operator should compare analytical results to the Evaluation Criteria to evaluate system performance. Once baseline concentrations are established for the performance monitoring wells and Operational and Adjustment Control Criteria are established, this O&M manual should be revised to identify the performance monitoring wells selected by EPA and Ecology and to identify the future operational and adjustment control criteria that will be the bases for evaluating (and modifying) extraction system operation.

Operator-initiated adjustments to the interception/extraction system should be limited to those adjustments described in Section 7.4.2. Exceedance of any concentration-based criteria for compliance monitoring wells (i.e., Evaluation Criteria) should be identified to the Spokane County project manager for evaluation of appropriate action.

7.3.2 Consent Decree Monitoring, Operation, and Shutdown Criteria

The consent decree specifies a number of criteria that affect monitoring, operation, and shutdown of the RA. Although the decision to adjust or modify the operation of the RA based on exceedance or achievement of these criteria (as applicable) should be made by the Spokane County project manager, it is important that the operator understand the decision process for these activities so that operational adjustments are consistent with the consent decree requirement. Figure 7-10 illustrates the decision logic for groundwater monitoring for the South and West Interception Systems associated with the consent decree. Figure 7-11 illustrates the decision logic for operation and shutdown of the South and West Interception Systems as specified in the consent decree.

The decision logic presented on Figures 7-10 and 7-11 is for illustrative purposes only. Many of the decisions require technical analyses, and some decisions require the concurrence of EPA and Ecology prior to implementation. As a result, the operator should not implement any of the decisions identified in Figures 7-10 and 7-11 without direction from the Spokane County project manager.

7.4 OPERATIONAL CONTROL

The goals of operational control for the groundwater extraction system are to prevent further migration of the Constituents of Concern in the aquifers, to provide source control, and to minimize the impact of the RA on the beneficial use of affected aquifers. Achieving these three goals requires careful management of RA groundwater extraction rates.

7.4.1 Initial Operational Settings

Although the goal of the extraction system is to achieve the groundwater performance criteria described in Section 7.3.1, normal operation of the system will be based on achieving the aquifer drawdowns required for effective hydraulic control and interception of contaminated groundwater. The initial operational settings for South and West Interception Systems extraction wells reflect the model-predicted flow rates needed to capture the contaminated groundwater plumes. The flow rates used for RA design are provided in Table 7-1. Although these flow rates provide an initial setting for system operation (a starting point), a better measure of the effectiveness of the South and West Interception Systems is whether they create the drawdown

predicted by the model as necessary to achieve contaminant capture. The model-predicted drawdown (target drawdown) and approximate prepumping groundwater elevations for compliance monitoring wells, as well as other wells that will be used to evaluate RA hydraulic performance, are provided in Table 7-4. The location of these wells are shown on Figure 7-5.

7.4.2 Operational Adjustments

Operational adjustments may be required to achieve the target drawdowns identified in Table 7-4 or to address exceedance of the concentrations-based performance criteria discussed in Section 7.3.1. The primary operational adjustment for the interception/extraction systems will be modification of extraction well pumping rate. The discussion within this O & M manual is limited to operational adjustments to achieve the target drawdowns. Adjustments to address exceedance of concentration-based criteria are discussed in Section 7.6.

It is important to recognize that the aquifers will take a significant length of time to achieve the ultimate drawdown that will result from the startup or change in pumping rate for an extraction well. The groundwater flow model predicts it will take about 2 years to reach steady state in the Upper Sand/Gravel Aquifer (South System) and about 2 months in the Lower Sand/Gravel Aquifer (West and East Systems). Thus, a significant period of time must elapse from startup or adjustment of a well before the impact of the action on aquifer drawdown can be fully observed. It is recommended that the Upper Aquifer be allowed to stabilize for at least 120 days, or until the change in water elevation is less than 0.1 ft in the affected monitoring wells for a period of 60 days (whichever occurs later), following startup or significant operational adjustment to one or more monitoring wells, prior to evaluating whether the adjustment has achieved its intended purpose. It is recommended that the Lower Aquifer be allowed to stabilize for at least 60 days, or until the change in water elevation is less than 0.1 ft for a period of 30 days (whichever occurs later).

It should also be recognized that the target drawdowns identified in Table 7-4 are based on a numerical groundwater flow model, and thus, are only estimates. If these values cannot be achieved at pumping rates within about ± 40 percent of the estimated flow rates in Table 7-1, it may be necessary to verify the accuracy of the groundwater flow model and to reevaluate flow rates and target drawdowns based on that reevaluation.

Once the extraction system achieves stable drawdown within the aquifer, target drawdowns should be compared to observed drawdowns for the wells identified in Table 7-4 to evaluate whether adequate capture is being achieved. Because of the uncertainties associated with the accuracy of the groundwater flow model and aquifer conditions, it is recommended that observed drawdowns exceed the target drawdowns by about 20 percent, provided this additional drawdown can be achieved within the operational range of the system.

If system adjustment is required to achieve target drawdowns, adjustments should be made to extraction wells that most directly affect (i.e., are in the closest proximity to) the monitoring well or wells not achieving the target drawdown. Extraction well water quality should also be considered; if other considerations are equal, it would be preferable to extract more highly contaminated water, provided doing so does not result in exceedance of discharge water quality criteria.

The relationship between extraction rate and drawdown will vary depending on site specific conditions. Under ideal conditions, a linear relationship exists between pumping rate and drawdown for steady state conditions. This relationship can be used to estimate the pumping rate adjustment needed to achieve the target drawdown:

$$\frac{S_o}{Q_o} = \frac{S_T}{Q_T} \rightarrow Q_T = \frac{S_T}{S_o} Q_o$$

$$\Delta Q = Q_T - Q_o$$

Where S_o = Observed drawdown (ft)

Q_o = Discharge rate required to achieve ΔS_o (gpm)

S_T = Target drawdown (ft)

Q_T = Discharge rate required to achieve ΔS_T (gpm)

ΔQ = Discharge rate adjustment (gpm)

Because multiple extraction wells are present, this estimate must be made using system-averaged values for discharge rates and observed drawdown. The calculated discharge rate adjustment (ΔQ) can then be distributed to the extraction well or wells that will most effectively achieve the change (increase or decrease in drawdown) for the portion of the aquifer of interest.

In most cases, adjustment of pumping rates will be an iterative process. That is, it may require three or four (sequentially smaller) adjustments to achieve the target value. When an adjustment is made, sufficient time should be allowed prior to evaluating the effectiveness of the adjustment, as previously described in this section. However, if an adjustment results in an aquifer response that is greater than intended, it may be appropriate to reduce the adjustment prior to system stabilization.

7.5 AQUIFER MONITORING REQUIREMENTS

Aquifer monitoring requirements include the water quality monitoring requirements specified by the consent decree or required for operational purposes, and the groundwater elevation data needed to evaluate whether the South and West Interception Systems are achieving the drawdowns predicted by the groundwater flow model. Specific water quality monitoring requirements are fully described in the Field Sampling Plan for the Quality Assurance Project Plan (QAPP; Landau Associates 1994), but are briefly described herein, as are groundwater elevation monitoring requirements.

7.5.1 Water Quality Monitoring

Downgradient and crossgradient compliance monitoring wells are to be sampled and analyzed for the four indicator compounds (TCA, DCA, DCE, and TCE) of the six Constituents of Concern identified in Table 7-3. Downgradient compliance monitoring wells must be sampled and analyzed for the four indicator compounds monthly for a period of 2 years following RA startup to develop baseline groundwater concentrations. Crossgradient monitoring wells, and downgradient monitoring wells following the first 2 years of operational sampling, must be sampled and analyzed for the four indicator compounds quarterly for at least 3 years. All six Constituents of Concern must be analyzed for annually, for at least the first 5 years of operation. After 3 years of quarterly monitoring, the project consent decree allows a reduction in sampling frequency, and ultimately cessation of monitoring if Adjustment Control Criteria are not exceeded.

Compliance monitoring wells have been identified for the RA. The compliance monitoring system for the South Interception System consists of four downgradient monitoring wells (CD-31A, CD-36A, CD-37A, and CD-38A) and two crossgradient monitoring wells (CD-34A

and CP-S3). The downgradient compliance monitoring system for the West Interception System consists of 18 wells at six locations (a three-well cluster at each location; CD-41, CD-42, CD-43, CD-44, CD-45, and CD-48). The consent decree further specifies that these six monitoring locations for the West Interception System be subdivided into two groups (Set A and Set B) and identifies different performance criteria for each set of monitoring wells (see SOW, Section V, for additional description of Sets A and B performance criteria). The crossgradient compliance monitoring system for the West Interception System consists of the six wells at two of the downgradient compliance monitoring locations (CD-45 and CD-48). The South and West Systems compliance monitoring wells are identified in Table 7-5, and the well locations are shown on Figure 7-5.

7.5.2 Groundwater Elevation Monitoring

Groundwater elevation monitoring is needed to evaluate whether the extraction system is achieving the model-predicted target drawdowns and to periodically evaluate the regional impact of the RA on groundwater levels. Groundwater elevations should be measured at least monthly for the monitoring wells identified in Table 7-4, and drawdowns for these wells should be calculated based on the approximate prepumping water elevations also identified in Table 7-4. Once water levels have stabilized, drawdowns for these wells should be compared monthly to the model-predicted drawdowns identified in Table 7-4 to evaluate whether adequate drawdown is being achieved, or whether system adjustment is warranted. If system adjustment is needed, the procedures identified in Section 7.4.2 to estimate the appropriate discharge rate adjustment should be followed.

It should be recognized that groundwater elevations fluctuate seasonally. Available data suggest that groundwater elevations fluctuate up to about 1 ft in both the Upper and Lower Sand/Gravel Aquifers. Water elevations are typically highest in May or June and lowest in September or October. Once the target drawdowns are achieved, the pumping rates required to achieve those drawdowns should not be modified in response to water level fluctuations if these fluctuations are due to seasonal effects. The effect of seasonal fluctuations can be evaluated by plotting, water elevation versus time for selected monitoring wells, and evaluating the plots for seasonal trends. Additionally, the differential in water elevation between selected monitoring wells and the closest extraction well can be plotted over time once target drawdowns

are achieved, and as long as this differential remains relatively constant (plus or minus about 10 percent), adjustment to the system to address water level fluctuations is probably not necessary.

It is recommended that more extensive water level measurements be collected periodically, and drawdown estimated, to evaluate the regional impact of the RA. Tables 7-6 and 7-7 provide reference elevations and approximate prepumping groundwater elevations for wells screened in the Upper and Lower Aquifers, respectively. The locations of these wells are shown on Figures 7-12 and 7-13 for the Upper and Lower Aquifers, respectively. Water levels should be collected from the wells for assessing the regional impact of the RA. It is recommended that measurements be collected, and regional drawdown be evaluated, quarterly for the first 2 years of RA operation. The frequency of future measurements of regional drawdown should be determined based on the results of this initial 2-year monitoring effort.

7.6 SYSTEM ADJUSTMENT/MODIFICATIONS

As previously described, it may be necessary to adjust the interception/extraction systems to achieve the target drawdowns, and procedures for these operational adjustments are described in this O & M manual. However, if extraction system adjustment or modification is needed because of exceedance of the groundwater quality criteria specified in the project consent decree, if an adjustment of greater than about ± 40 percent of the predicted pumping rate is required, or if a physical modification to the system is required to achieve the target drawdown, additional evaluation should be performed prior to proceeding with the adjustment or modifications.

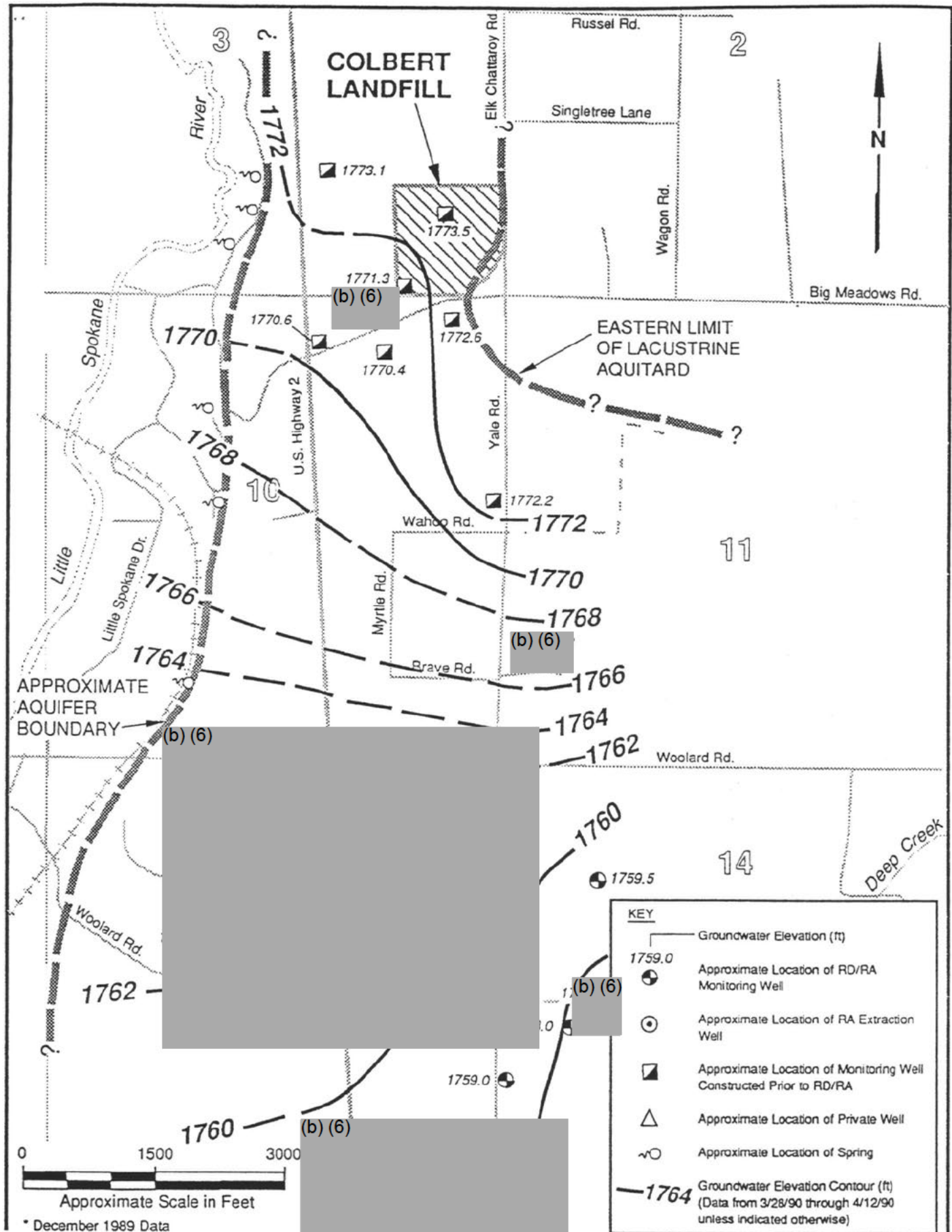
The most probable initial step for additional evaluation would be modification and verification of the groundwater flow model used for interception/extraction system design. The groundwater flow model was not modified to incorporate hydrogeologic data resulting from the construction of monitoring and extraction wells constructed for the RA (Phase II construction). Addition of these data may result in revised target drawdowns that demonstrate that capture would be achieved without system modification.

Similarly, verification of the groundwater flow model (comparison of model-predicted drawdowns to observed drawdowns, and modification of the model if appropriate) may be advisable if actual drawdowns vary significantly from predicted values. If a significant difference exists between actual and model-predicted aquifer response, it may be necessary (and

more cost-effective) to modify the model to better predict aquifer drawdown than to adjust pumping rates to achieve inappropriate target drawdowns.

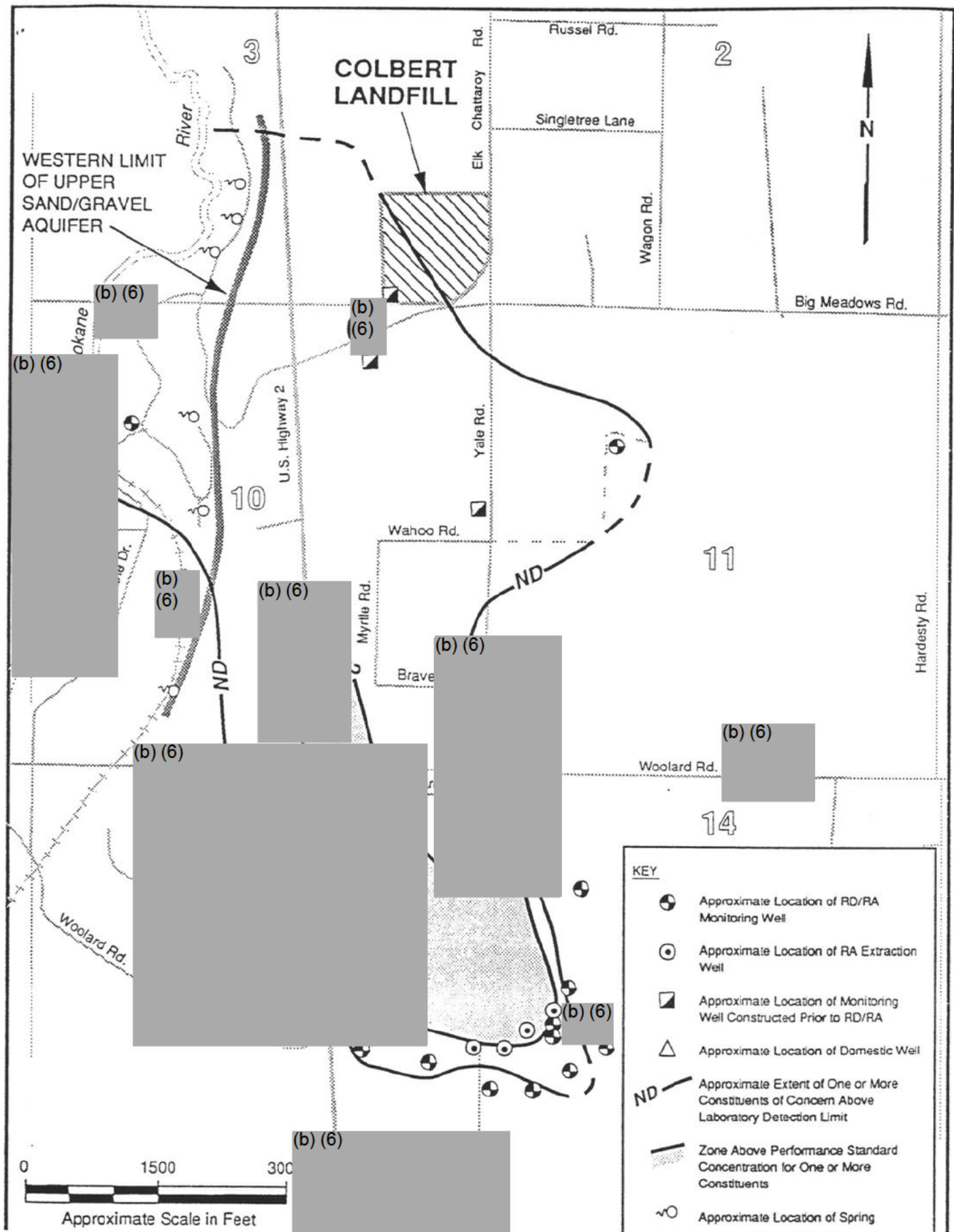
If additional groundwater modeling, or other evaluation, indicates that interception/extraction system modification is needed to achieve drawdown or consent decree performance requirements, modifications may consist of installation of higher capacity pumps in existing wells, or the construction of new extraction wells. These system modifications would require additional engineering design. Implementation of groundwater modelling, or system adjustment or modification beyond that described in Section 7.4.2, is beyond the scope of this O & M manual. If operational conditions are encountered that indicate these actions may be warranted, the operator should inform the Spokane County project manager of the situation. It will then be the project manager's responsibility to determine appropriate further actions.

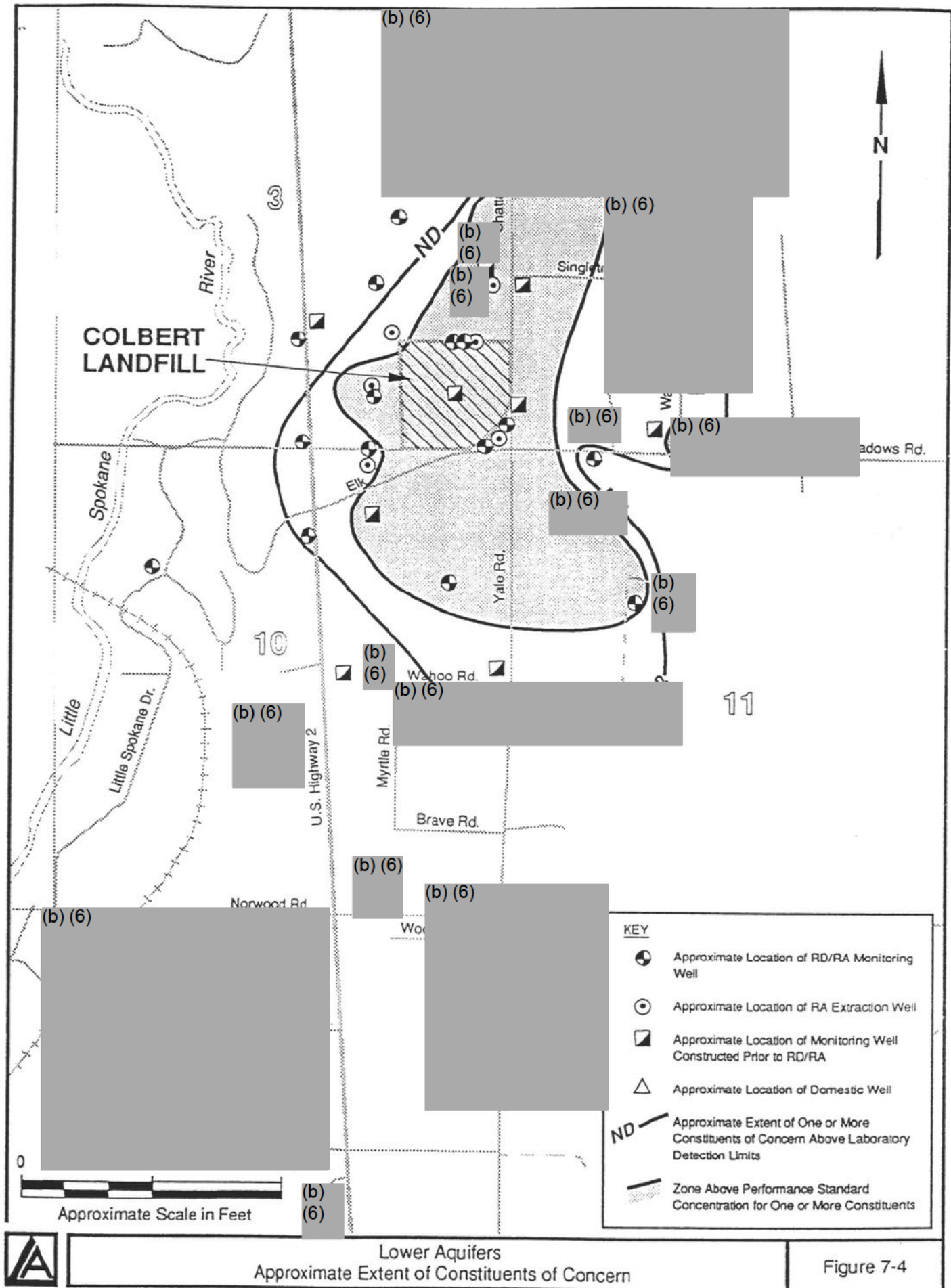
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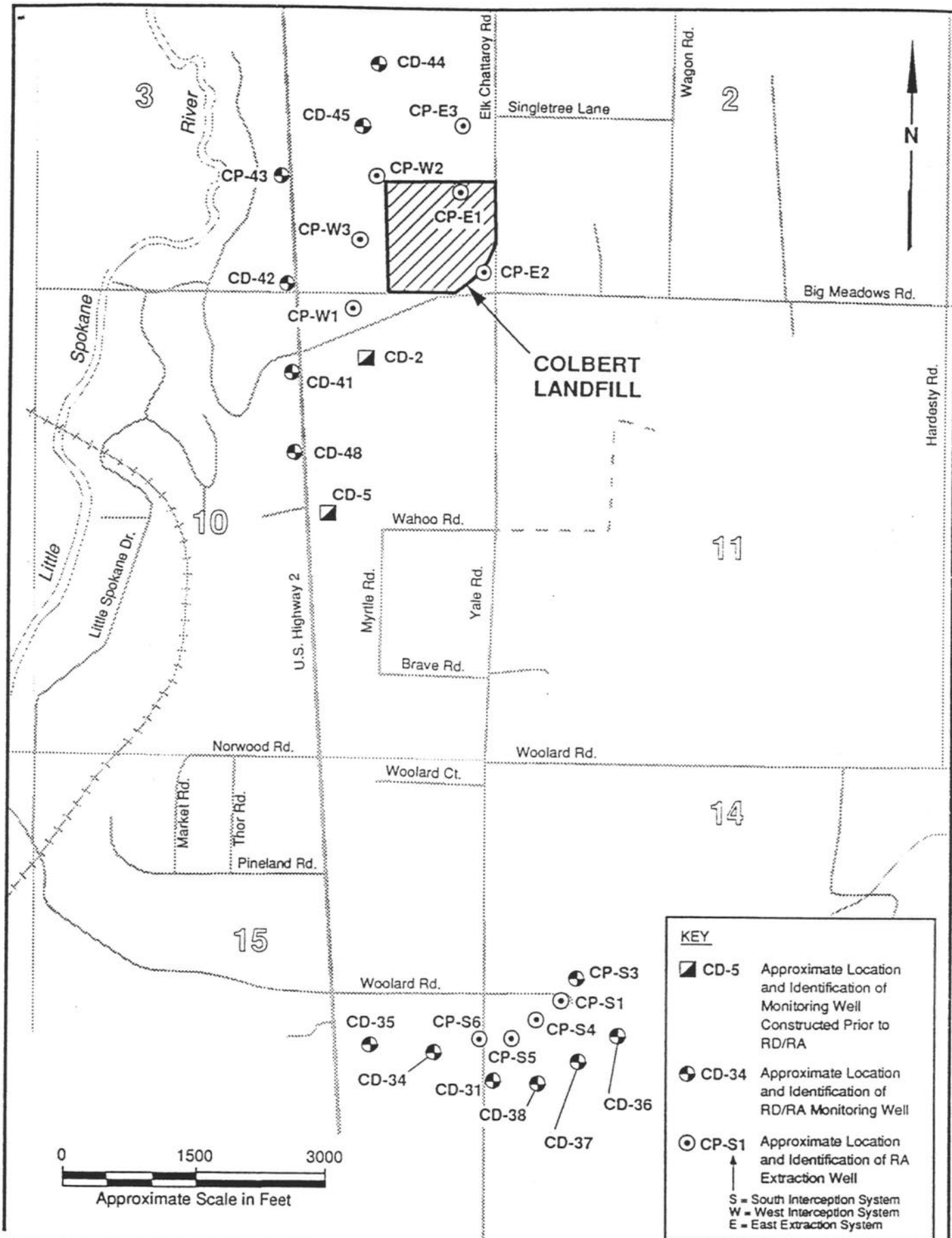


Upper Sand/Gravel Aquifer
Groundwater Elevation Contours

Figure 7-1

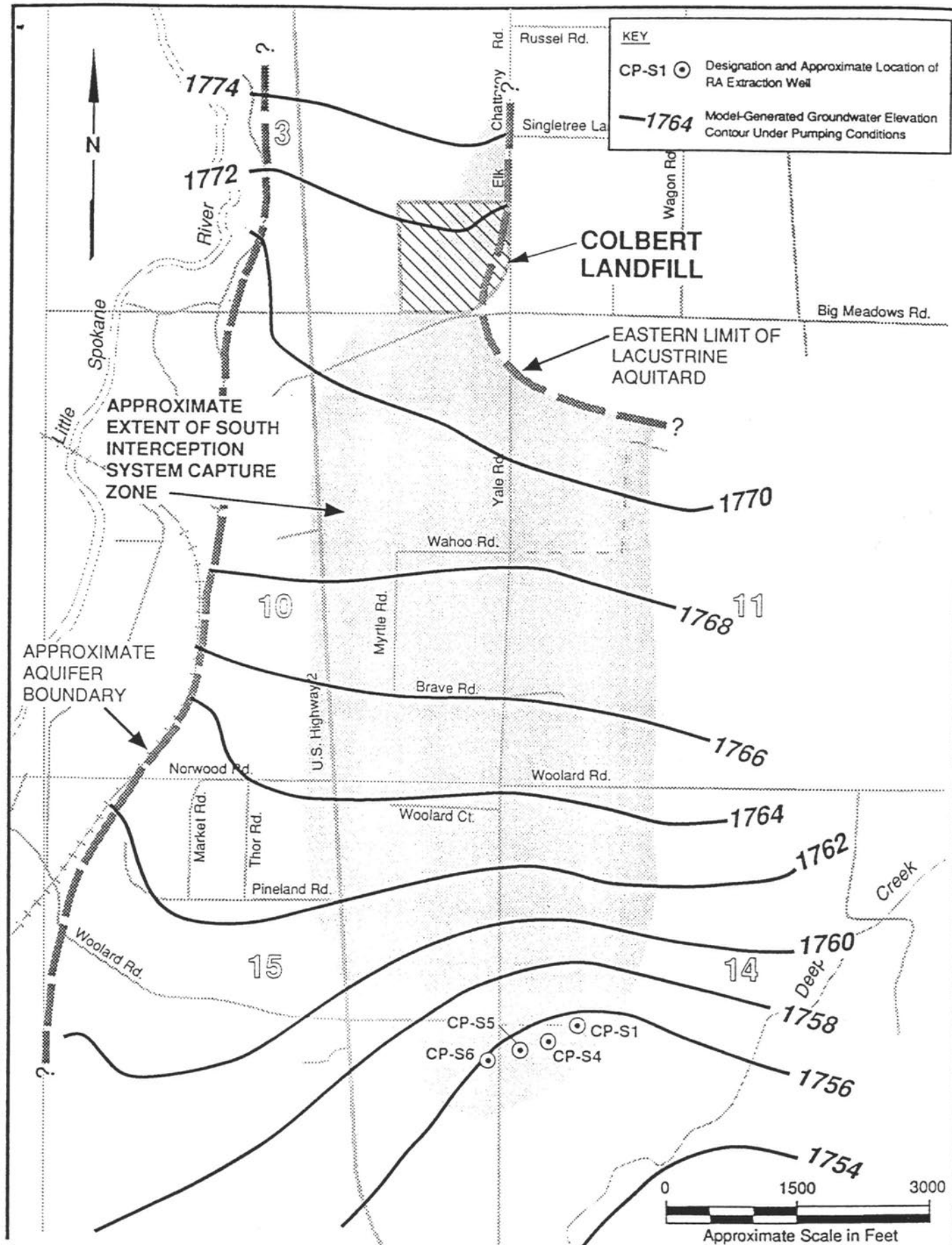






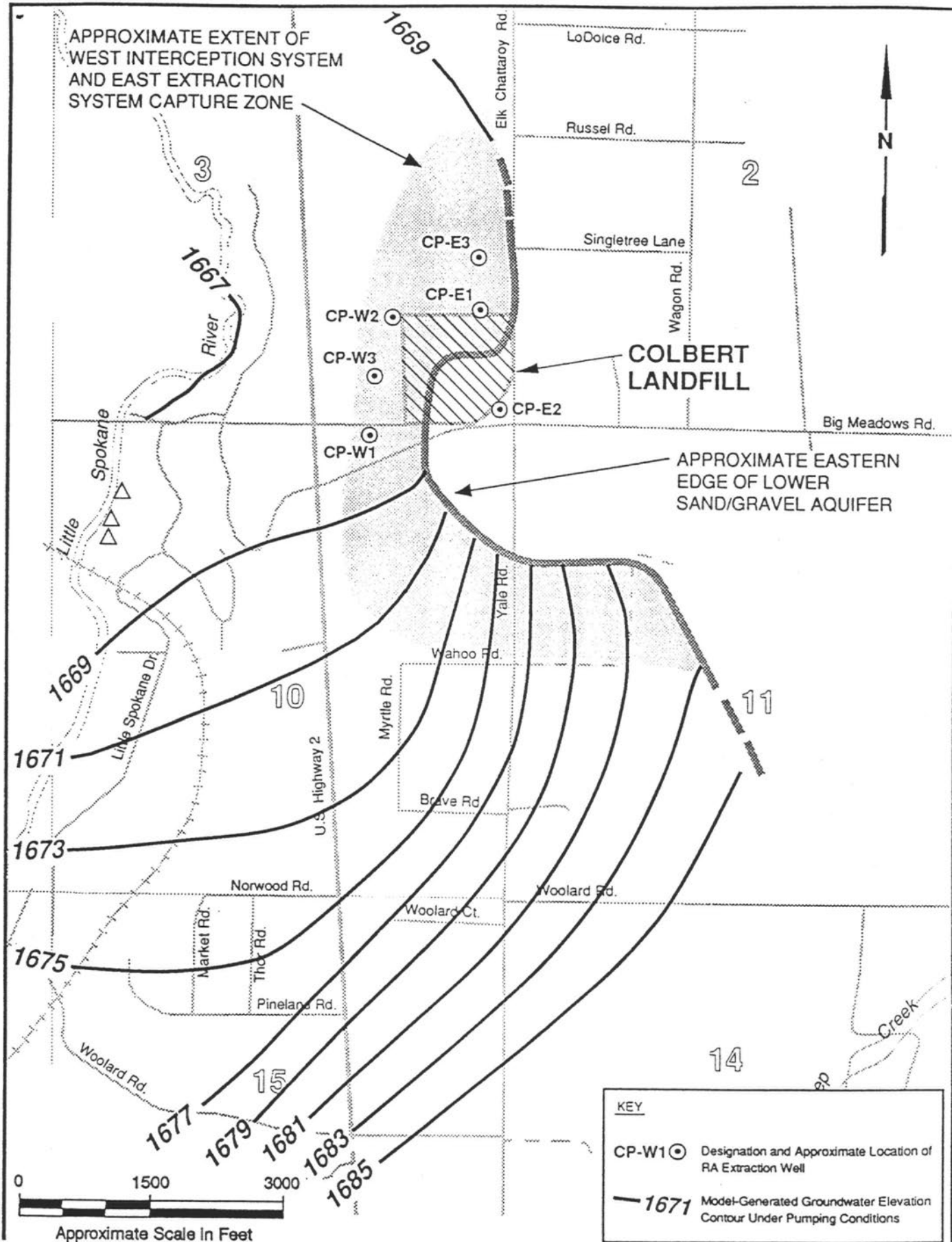
Extraction and Compliance Monitoring Well Location Map

Figure 7-5



South Interception System Capture Zone

Figure 7-6



Combined West Interception and East Extraction System Capture Zone

Figure 7-7

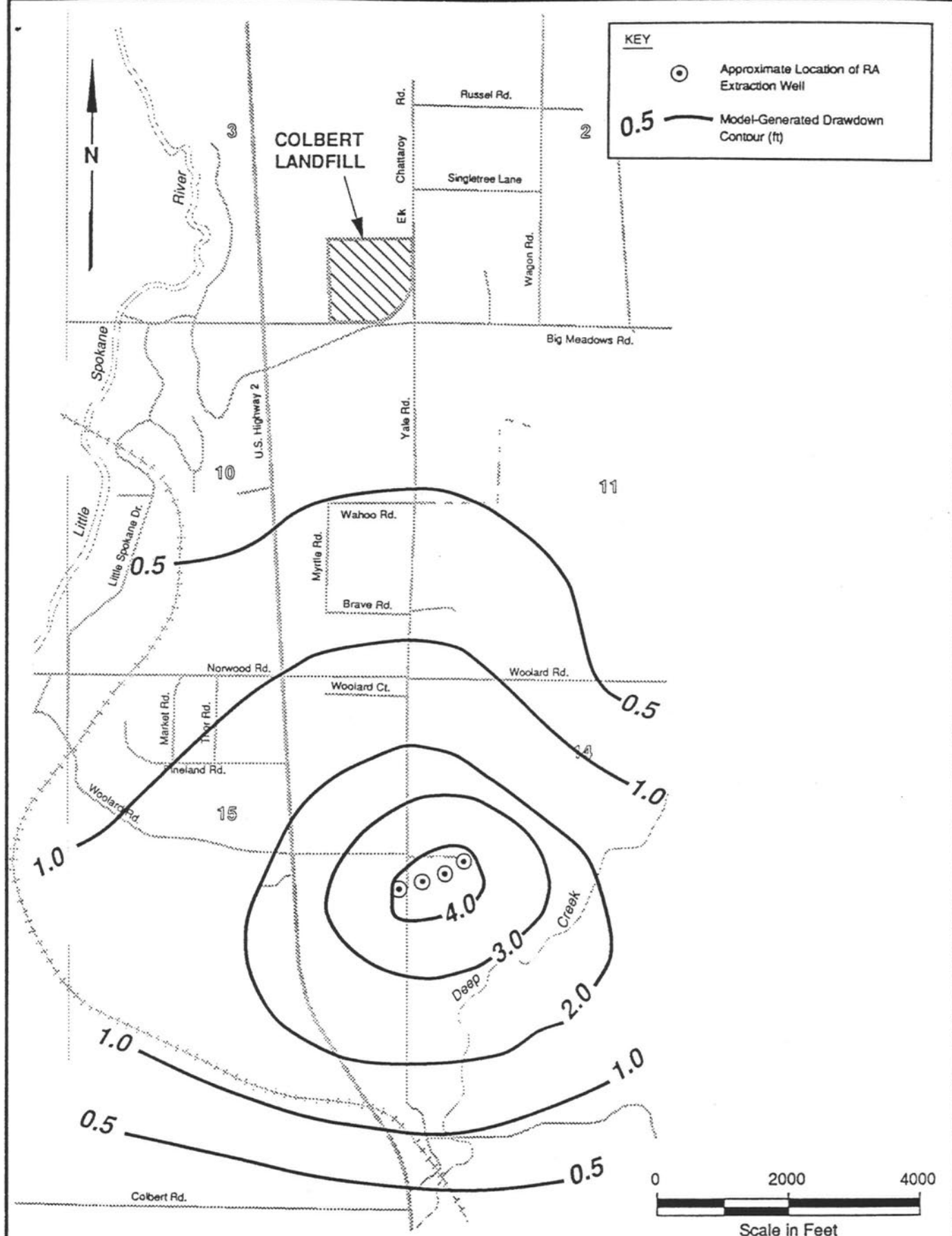
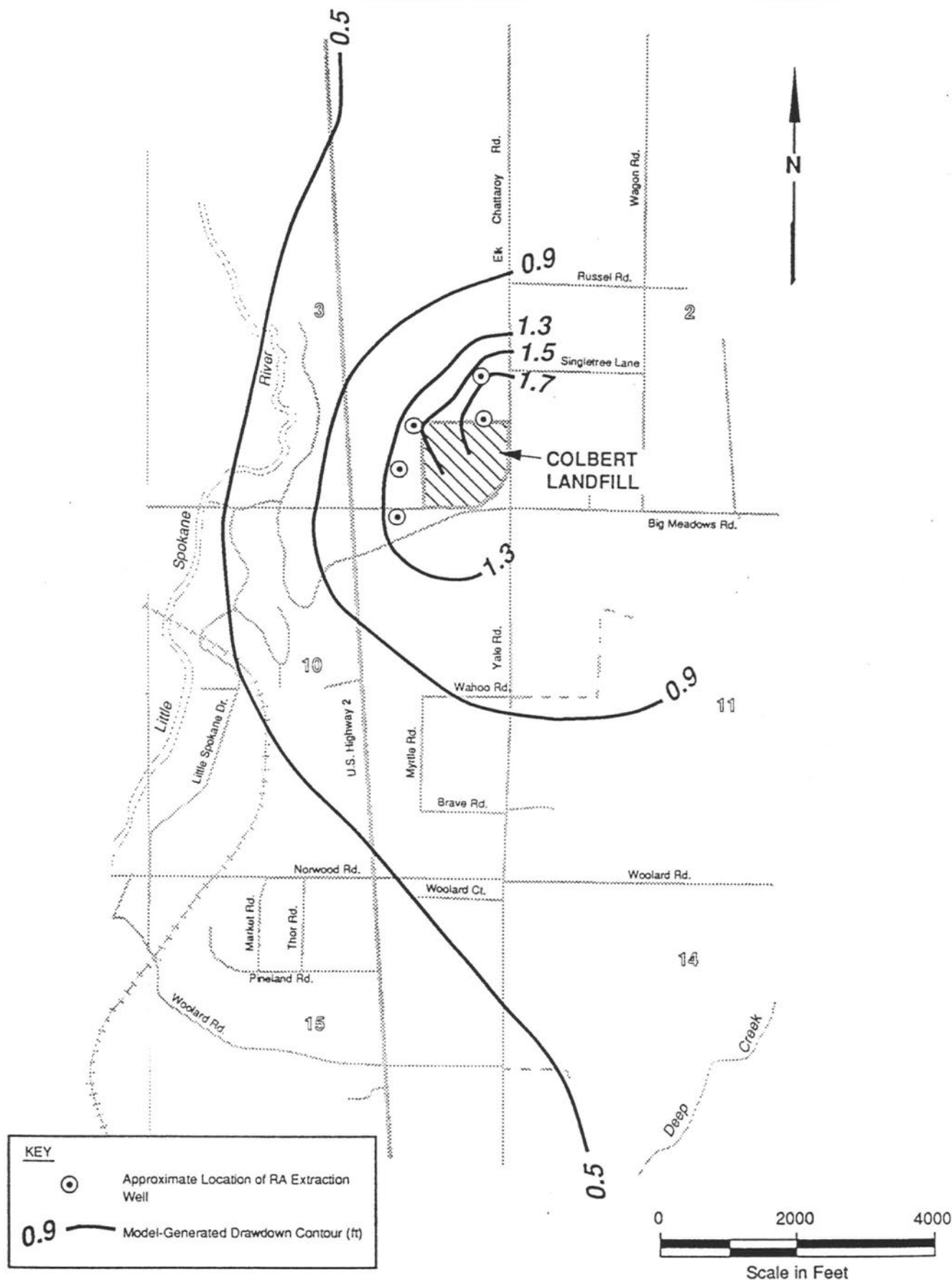


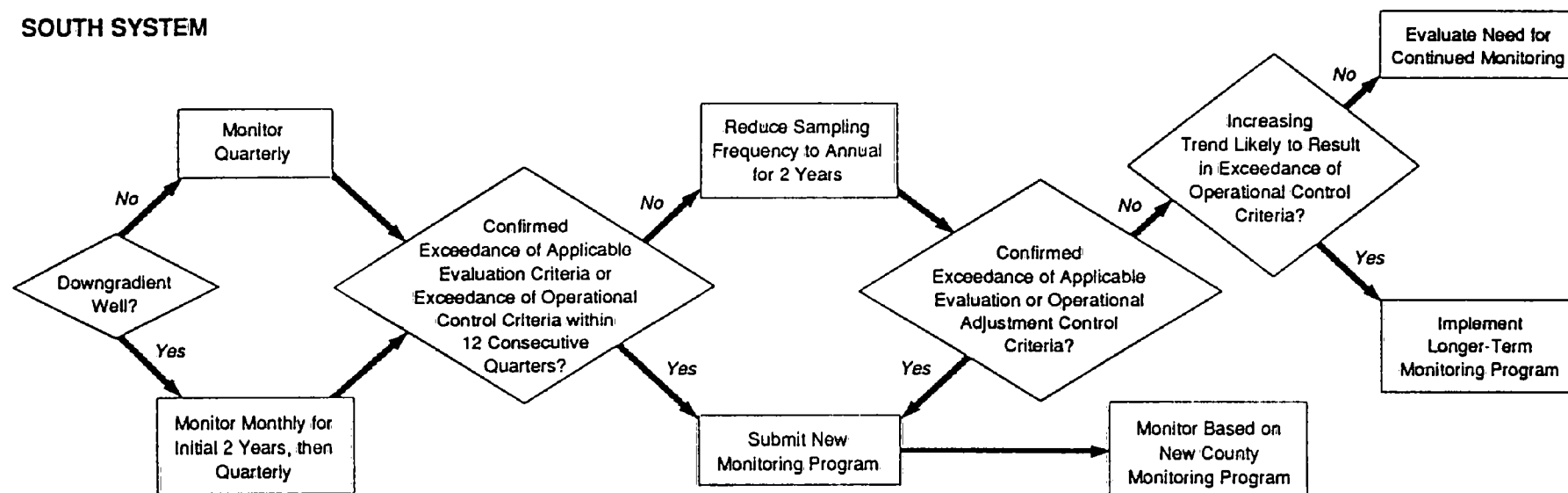
Figure 7-8



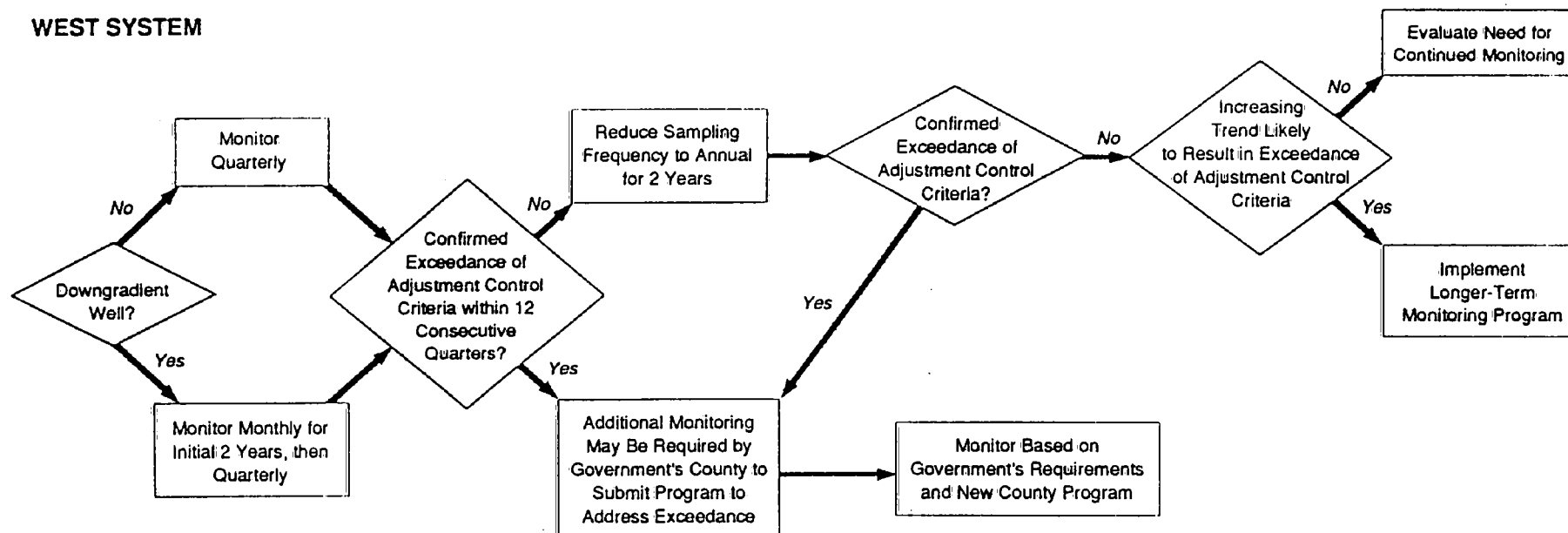
Lower Sand/Gravel Aquifer
Anticipated Regional Drawdown

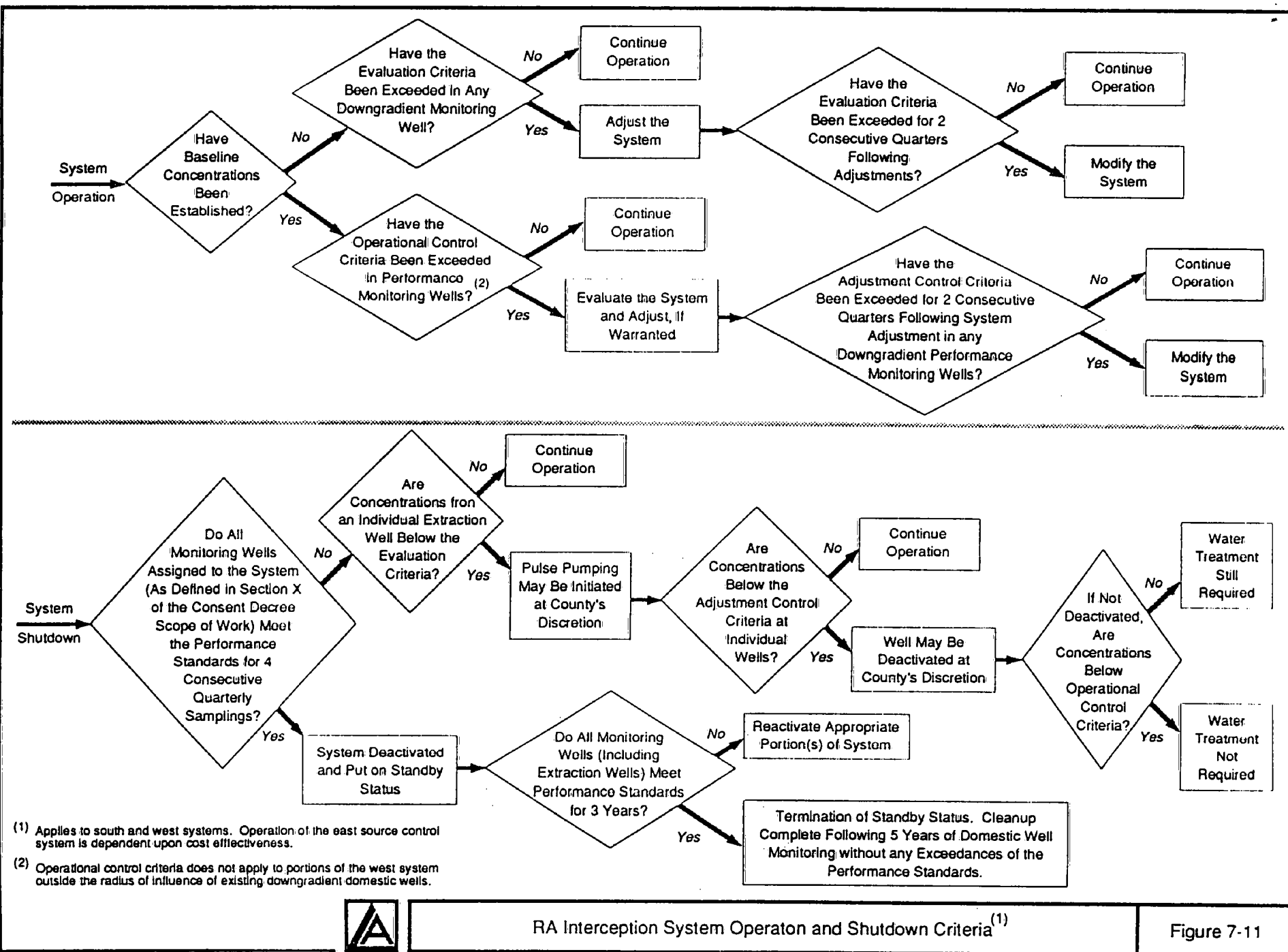
Figure 7-9

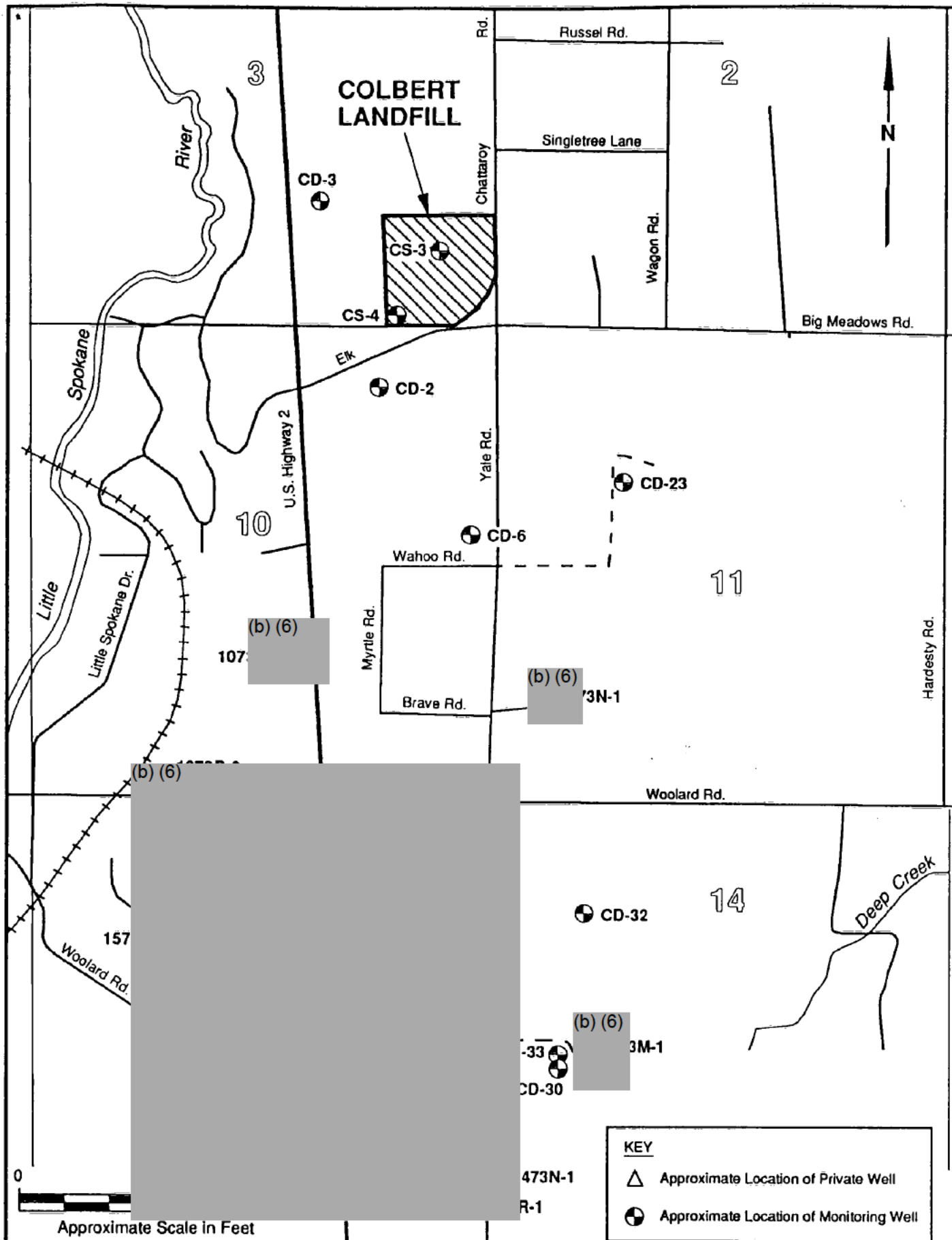
SOUTH SYSTEM



WEST SYSTEM

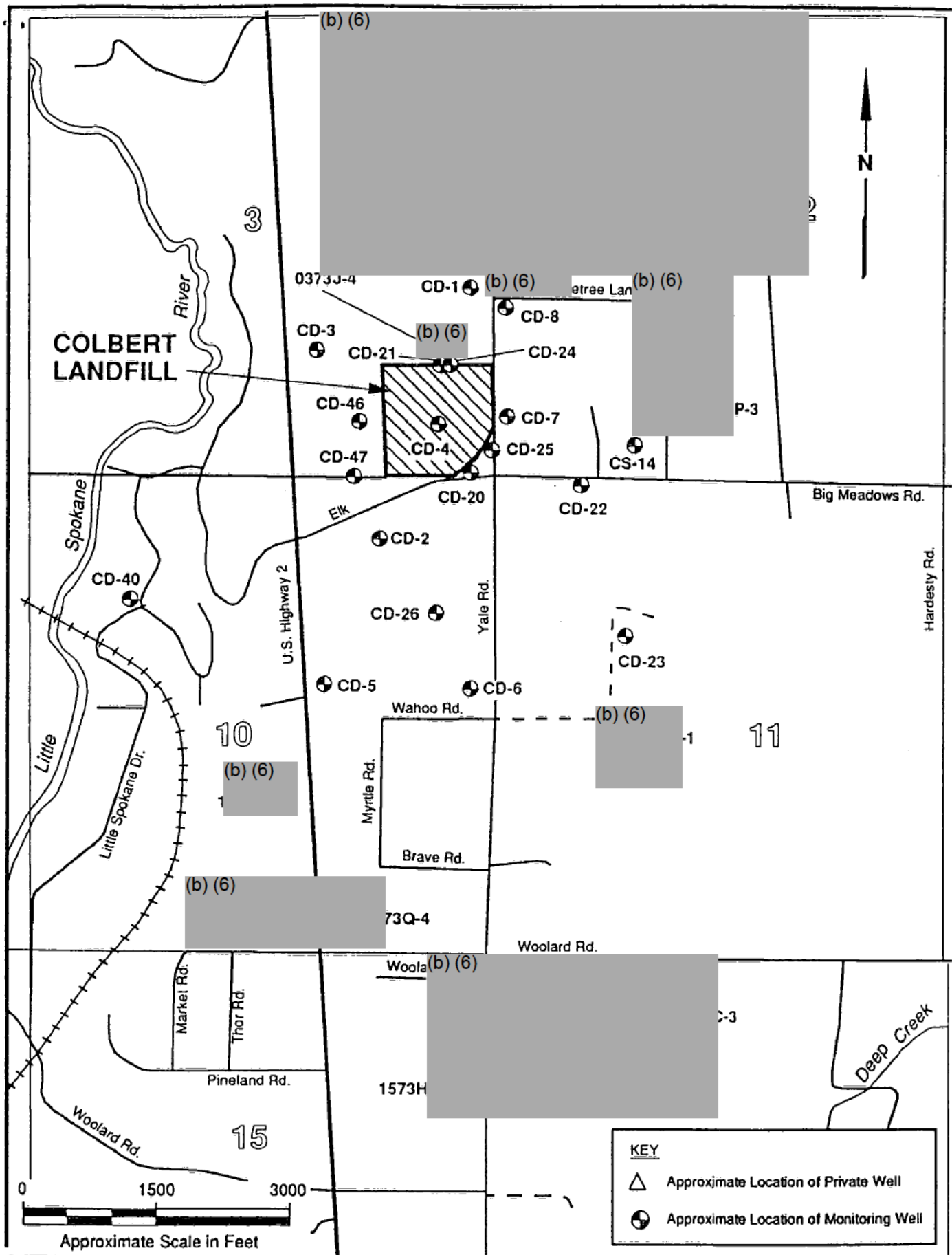






Upper Aquifers
Private Well and Monitoring Well Location Map

Figure 7-12



Lower Aquifers
Private Well and Monitoring Well Location Map

Figure 7-13

TABLE 7-1
DESIGN FLOW RATES
RA INTERCEPTION AND EXTRACTION SYSTEMS^(a)

Interception/ Extraction System	Extraction Well Designation	Model-Predicted		System Design	
		Lower Bound Flow Rate	Upper Bound Flow Rate	Minimum Flow Rate	Maximum Flow Rate
<u>South</u>	CP-S1	50	60	--	--
	CP-S4	50	60	--	--
	CP-S5	50	50	--	--
	CP-S6	50	60	--	--
Subtotal		200	230	200	400
<u>West</u>	CP-W1	80	170	--	--
	CP-W2	70	130	--	--
	CP-W3	120	230	--	--
Subtotal		270	530	250	900
<u>East</u>	CP-E1 ^(b)	60	80	--	--
	CP-E2 ^(c)	5	5	--	--
	CP-E3 ^(b)	50	65	--	--
	CP-E4 ^(b)	50	65	--	--
Subtotal		115	150	150	300
System Total		585	910	600	1,600

(a) Flow rates in gallons per minute (gpm).

(b) Flow rates predicted to assist West Interception System capture. Higher flow rates may be utilized for source control.

(c) Well not in model domain. Pumping rate based on Phase I pumping test results.

TABLE 7-2

WATER ELEVATION AND DRAWDOWN INFORMATION
FOR RA EXTRACTION WELLS

Location	Approximate Prepumping Water Elevation ^(a) (ft)	Minimum Water Elevation ^(b) (ft)	Model- Predicted Drawdown	Maximum Available Drawdown ^(c) (ft)
West System				
CP-W1	1668.8	1582	4.2	87
CP-W2	1668.8	1611	2.4	58
CP-W3	1668.7	1624	3.0	45
South System				
CP-S1	1758.3	1744	6.4	14
CP-S4	1758.9	1750	6.4	9
CP-S5	1757.5	1749	6.1	8
CP-S6	1757.8	1749	6.2	9
East System				
CP-E1	1669.0	1635	3.6	34
CP-E2	1716.2	1686	NA ^(d)	30
CP-E3	1669.1	1645	3.6	24

(a) Water elevations from June 1993.

(b) Minimum water elevation based on depth to top of pump.

(c) Maximum allowable drawdown = approximate prepumping water elevation - minimum water elevation.

(d) Well is not located within model domain. Well should be pumped at the rate necessary to achieve maximum available drawdown.

TABLE 7-3

PROJECT CONCENTRATION-BASED CRITERIA^(a)

Constituent of Concern	Performance Standards	Evaluation Criteria
1,1,1-Trichloroethane (TCA)	200	200
1,1-Dichloroethylene (DCE)	7	7
1,1-Dichloroethane (DCA)	4,050	4,050
Trichloroethylene (TCE)	5	5
Tetrachloroethylene (PCE)	0.7	7
Methylene chloride (MC)	2.5	25

(a) All concentrations in parts per billion (ppb).

TABLE 7-4

APPROXIMATE PREPUMPING GROUNDWATER ELEVATIONS
AND PREDICTED DRAWDOWN FOR SELECTED MONITORING WELLS

Location	Approximate Prepumping Water Elevation (ft) ^(a)	Predicted Steady State Drawdown (ft)
Upper Sand/Gravel Aquifer		
CP-S3A	1758.7	3.2
CD-31A	1759.8	3.2
CD-34A	1760.3	2.9
CD-35A	1760.5	2.2
CD-36A	1754.1	2.8
CD-37A	1755.7	3.0
CD-38A	1757.2	3.1
Lower Sand/Gravel Aquifer		
CD-41C1	1669.6	0.8
CD-41C2	1669.6	0.8
CD-41C3	1669.7	0.8
CD-42C1	1668.4	1.1
CD-42C2	1668.2	1.1
CD-42C2	1668.4	1.1
CD-43C1	1667.6	1.0
CD-43C2	1667.9	1.0
CD-43C3	1668.8	1.0
CD-44C1	1669.7	1.0
CD-44C2	1669.7	1.0
CD-44C3	1669.6	1.0
CD-45C1	1669.1	1.3
CD-45C2	1669.1	1.3
CD-45C3	1669.1	1.3
CD-48C1	1671.4	0.6
CD-48C2	1671.3	0.6
CD-48C3	1671.2	0.6
CD-02C1	1669.1	1.2
CD-05C2	1673.7	0.5

(a) Based on April 1994 measurements.

TABLE 7-5

RA COMPLIANCE MONITORING WELLS

Monitoring System/Function	Monitoring Well Designation
West Monitoring System	
Downgradient - Set A	CD-41C1 CD-41C2 CD-41C3 CD-42C1 CD-42C2 CD-42C3 CD-48C1 CD-48C2 CD-48C3
Downgradient - Set B	CD-43C1 CD-43C2 CD-43C3 CD-44C1 CD-44C2 CD-44C3 CD-45C1 CD-45C2 CD-45C3
Crossgradient	CD-45C1 CD-45C2 CD-45C3 CD-48C1 CD-48C2 CD-48C3
South Monitoring System	
Downgradient	CD-31A CD-36A CD-37A CD-38A
Crossgradient	CD-34A CP-S3

TABLE 7-6

**SUPPLEMENTAL UPPER AQUIFER GROUNDWATER MONITORING AND PRIVATE WELLS
FOR WATER LEVEL MEASUREMENTS**

Well	Aquifer ^(a)	Reference Elevation ^(b) (MSL)	Groundwater Elevation ^(c) (MSL)
MONITORING WELLS			
CD-2 S	A1	1853.87	1771.3 ^(d)
CD-3 M	A1	1845.01	1773.3
CD-6 U	A1	1856.94	1772.4
CD-23	B1	1860.51	1781.6
CD-30	A1	1845.95	1758.1
CD-32	B1	1853.44	1759.8
CD-33	A1	1846.57	1758.1
CS-3	A1	1864.13	1774.6
CS-4	A1	1858.38	1771.8
CS-10	A1	1849.77	NA ^(e)
PRIVATE WELLS			
1573R-1 (b) (6)	NA	1851.75	1759.9
1473N-1	NA	1844.62	NA
1473M-1	NA	1839.15	1757.4
1573H-4	NA	1856.95	NA
1573F-3	NA	1840.58	NA
1073P-2	NA	1838.67	1764.6
1573Q-1	NA	1839.13	1760.0
1173N-1	NA	1858.61	NA
1573K-1	NA	1850.33 ^(f)	1760.4
1573B-3	NA	1844.66	1761.4
1573A-1	NA	1854.60	NA
1073K (1)	A1	1843.74	1764.1
1573C-8	NA	1841.13	1762.4

- (a) A = Upper Sand/Gravel Aquifer; B = Lacustrine Aquitard; number represents relative position in the aquifer, with "1" near top, "2" in middle unit, and "3" near base.
- (b) Reference elevation is top of PVC casing for monitoring wells and access port for private wells, unless otherwise indicated.
- (c) Monitoring well data is from one measurement taken June 1993, unless otherwise noted.
- (d) Data is from average of two measurements taken June 1993 and April 1994.
- (e) NA = information not available.
- (f) Surveyed at angled port access; 0.35 ft must be subtracted from the depth to water reading due to angled access.

TABLE 7-7

**SUPPLEMENTAL LOWER AQUIFER GROUNDWATER MONITORING AND PRIVATE
WELLS FOR WATER LEVEL MEASUREMENTS**

Well	Aquifer ^(a)	Reference Elevation ^(b) (MSL)	Groundwater Elevation ^(c) (MSL)
MONITORING WELLS			
CD-1	C2	1853.4 ^(d)	1669.3
CD-2 D	C2	1853.93	1669.2 ^(e)
CD-3 L	C1	1845.00	1668.3
CD-4 L	E1	1867.61	1669.2
CD-5	C2	1854.33	1673.7 ^(e)
CD-6 L	C2	1861.60	1680.7
CD-7 L	E1	1866.94	1711.2
CD-8	E1	1866.76	1678.5
CD-8 L	E2	1866.74	1676.3
CD-20	E1	1864.58	1716.2
CD-20	E2	1865.00	1716.2
CD-21	C1	1855.88	1669.2 ^(e)
CD-21	C3	1857.38	1669.4 ^(e)
CD-22	D1	1865.35	1773.1
CD-23	C2	1861.08	1689.8
CD-24	C2	1859.85	1669.2 ^(e)
CD-25	E2	1865.00	1714.8
CD-26	C2	1860.79	1675.9
CD-40	C1	1671.67	1661.4
CD-40	C2	1671.84	1667.2
CD-40	C3	1672.29	1663.4
CD-46	C2	1852.61	1668.4
CD-47	C2	1850.88	1668.8
CS-14U	C1	1868.25	1784.7
CS-14 L	D1	1868.19	1784.7

TABLE 7-7

**SUPPLEMENTAL LOWER AQUIFER GROUNDWATER MONITORING AND PRIVATE
WELLS FOR WATER LEVEL MEASUREMENTS**

Well	Aquifer ^(a)	Reference Elevation ^(b) (MSL)	Groundwater Elevation ^(c) (MSL)
PRIVATE WELLS			
0273L-1 (b) (6)	NA	1888.08	1732.9
1173L-1	NA	1855.33	1683.4
0273M-1	C/E/F	1867.69	1670.8
0273P-3	E1	1863.53	1785.2
1573H-1	NA	1851.55	1683.7
1073P-3	C1	1838.79	1679.0
0273F-4	NA	1884.75	NA
0273F-1	NA	1890.60	1743.5
0373A-2	NA	1837.21	1672.8
1473D-1	NA	1855.97	1683.8
0273E-3	C1	1889.09	1747.0
0373A-4	C1	1870.64	1674.7
1473C-3	C1	1848.50	1684.6
0373J-5	F1	1860.41	1670.8
0273C-1	F1	1887.69	1801.9
1073L-4	NA	1841.52	1675.4
0373J-4	NA	1890.17	1763.4

- (a) C = Lower Sand/Gravel Aquifer; D = Latah Aquitard; E = Basalt Aquifer; F = Granite Aquitard; number represents relative position in the aquifer, with "1" near top, "2" in middle, and "3" near base.
- (b) Reference elevation is top of PVC for monitoring wells and access port for private wells.
- (c) Monitoring well data is from one measurement taken June 1993, unless otherwise noted.
- (d) Reference point is top of steel casing.
- (e) Data is from average of two measurements taken June 1993 and April 1994.

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Interim Draft

**Operation and Maintenance Manual
Section 8
Quality Assurance Project Plan**

August 10, 1994

Prepared for

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8.0 QUALITY ASSURANCE PROJECT PLAN

This Quality Assurance Project Plan (QAPP) establishes the quality assurance (QA) objectives during operation of the Colbert Landfill (landfill) remedial action (RA); the QA organization and procedures developed to meet QA and project objectives; the QA and quality control (QC) protocols and procedures associated with sampling and analysis of groundwater and treatment system influent/effluent; and data quality objectives (DQOs). The DQOs established for the project reflect the intended use of project data and, as such, prescribe the level of quality, accuracy, precision, completeness, comparability, and representativeness of data to be collected and analyzed. To assure quality data, this QAPP establishes specific procedures for sample collection and handling; sample custody; equipment calibration procedures and frequency; laboratory analytical procedures; data reduction, validation, and reporting; internal QC; performance and system audits; preventative maintenance; and data assessment procedures, corrective actions, and QA reports.

This QAPP addresses QA/QC requirements for National Pollutant Discharge Elimination System (NPDES) discharge monitoring, which are interim requirements at this time. Revisions to this QAPP may be required at the end of the interim period, if the final NPDES discharge monitoring requirements vary from the interim requirements.

Guidance used for preparation of this QAPP is contained in various U.S. Environmental Protection Agency (EPA) documents, including *The Quality Assurance Manual for Waste Management Branch Investigations, Region X* (EPA 1986a); *A Compendium of Superfund Field Operations Methods (EPA/540/P-87/001)* (EPA 1987a); and other EPA (1979, 1981, 1982, 1983, and 1984a) and National Institute of Occupational Safety and Health (NIOSH 1988) guidance manuals and handbooks.

This QAPP has been prepared by Landau Associates, Inc. (Landau Associates), engineering consultant to Spokane County (County) for operation of the RA. Compliance with the provisions of this QAPP will be the responsibility of the County, which may elect to contract with a firm or individuals to assist in meeting the provisions of this QAPP.

8.1 PROJECT OBJECTIVES

The primary objectives of RA activities are to operate a groundwater extraction, treatment, and discharge system that meets the performance requirements established in the Consent Decree.

Groundwater samples will be collected from compliance monitoring wells, extraction wells, and the RA treatment facility and analyzed for the Constituents of Concern and index parameters to evaluate compliance with the Consent Decree requirements, and for operational purposes.

The Consent Decree water quality criteria and NPDES effluent limits that are applicable during interim operation are shown in Table 8-1 and 8-2, respectively.

Groundwater and treatment system influent/effluent samples will also be collected during long-term Phase II operation.

8.2 PROJECT DATA QUALITY OBJECTIVES

The primary DQOs for activities are to obtain data of sufficient quality to provide a high degree of confidence in the data's precision, accuracy, representativeness, completeness, and comparability. The data will be used by EPA, Ecology, and the County to verify the effectiveness of the groundwater extraction, treatment, and discharge systems in meeting the requirements specified by the project Consent Decree and the NPDES interim discharge requirements.

The project objectives can be achieved using data of analytical level III, that is, data from analyte-specific, non-Contract Laboratory Program (CLP) procedures, as described by EPA (1987c). Level III is consistent with the Consent Decree SOW requirements. Rigorous attention will be paid to QA/QC to assure (to the degree practicable) that analytical data will be of high quality.

The QA procedures presented in this document were developed to assure that the DQO described above are met, as well as to assure that data generated are representative of treatment facility discharge water and groundwater conditions at the site. The overall goal of the project QA program is:

- To assure a reasonable degree of confidence in data collected in support of groundwater extraction, treatment, and discharge systems operation; and in results of associated assessments through the establishment of a rigorous system of quality and performance checks on data collection, analysis, and

reporting activities, as well as appropriate and timely corrective action to ensure compliance with established performance and quality criteria.

To accomplish this goal, the following QA project objectives have been established:

- To establish, with the complete support of project management, a project QA function that is sufficiently independent of project technical activities, in order to assure appropriate levels of review and surveillance of project activities and data
- To establish and define the duties and responsibilities of personnel involved in QA activities
- To establish effective systems for project documentation to assure proper development, use, and review of the data
- To establish QA procedures that provide for sufficient objective evidence to verify that laboratory, field sampling, and other technical activities are performed in accordance with established technical procedures and requirements.

As previously discussed, this QAPP presents the procedures and methods for sampling and sample handling, sample chain-of-custody, instrument/equipment calibration, chemical analysis, internal quality control, auditing, and data assessment developed to meet project and QA objectives.

8.3 PROJECT QUALITY ASSURANCE ORGANIZATION AND RESPONSIBILITIES

Spokane County, through its Project Manager (Spokane County Project Manager), is responsible for assuring compliance with the provisions of this QAPP. The County may elect to contract with an appropriate firm or individuals to provide the QA organization and personnel to assist the County in meeting the project QA responsibilities prescribed in this QAPP. While specific individuals with project QA responsibilities have not yet been identified, the QA organization will include, in addition to the Spokane County Project Manager, a Field Services Project Manager responsible for field and QA activities. If the County elects to conduct all QA activities internally, the Spokane County Project Manager and Field Services Project Manager positions could be combined. In addition, a separate QA Coordinator (QAC) and Laboratory QA Officer would need to be identified or contracted by the County.

The project QA organization, showing individuals with QA responsibility and lines of QA authority, is shown on Figure 8-1. Specific project QA responsibilities for the Field Services Project Manager, QAC, and Laboratory QA Officer are listed by responsible individuals in Table 8-3.

8.4 DATA QUALITY OBJECTIVES FOR PARCC PARAMETERS

The purpose of this section is to describe DQOs for precision, accuracy, representativeness, completeness, and comparability (PARCC) of project data. Specific procedures to be used for sampling, chain-of-custody, calibration, laboratory analysis, reporting, internal QC, audits, preventative maintenance, and corrective action are described in other sections of this QAPP. Detection limits are discussed in Section 8.8.

Samples will be analyzed in accordance with accepted analytical procedures selected from published methods contained in the following documents: *SW-846 Test Methods for Evaluating Solid Waste*, Third Edition (EPA 1986b) and *Standard Methods for the Examination of Water and Wastewater*, Sixteenth Edition (APHA-AWWA-WPCF 1985).

Influent/effluent samples will be analyzed for selected chemical and physical parameters to assess treatment system effectiveness and compliance with project discharge requirements.

8.4.1 Precision and Accuracy

Precision is a measure of mutual agreement among individual measurements of the same property under prescribed conditions. It is expressed as a standard deviation or relative percent difference on laboratory and blind field duplicates. Accuracy is the degree of agreement of a measurement (or an average of measurements of the same property), X , with an accepted reference or true value, T . Accuracy can be expressed as the difference between the two values ($X-T$), the difference as a percentage of the reference or true value ($100(X-T)/T$), or as a ratio (X/T). Accuracy is a measure of the bias in a system and will be expressed as the percent recovery of spiked samples and surrogates.

Accuracy and precision are determined through QC parameters such as surrogate recoveries, matrix spikes, matrix spike duplicates, laboratory duplicates, QC check samples, and blind field duplicates. The project DQOs for the evaluation of these parameters are based on those given in the method or on functional guidelines outlined by the EPA for evaluating inorganic and organic analyses (EPA 1988a,b, 1991). Project QC objectives for surrogate recovery control limits (expressed as a percent of recovery) and for matrix spikes and matrix spike duplicate control limits [expressed as a percent of recovery and relative percent difference (RPD)] are listed in Tables 8-4 and 8-5, respectively. Control limits listed in these tables are consistent with EPA guidelines contained in the specific methods. These control limits will be used as criteria for data acceptance. Specific control limits may be modified after selection of an analytical laboratory. If the required QC limit for replication or recovery is not met, corrective action will

be performed by the laboratory following the guidelines presented in Section 8.14. If the corrective action is performed and QC objectives still are not met, the QAC will be notified by the laboratory prior to data submittal, so that additional corrective action can be taken, if appropriate. Such action may include reanalysis of the sample or other determination to be made by the QAC and the Field Services Project Manager.

In addition to matrix spikes and matrix spike duplicates, QC samples for verification of precision and accuracy include laboratory duplicates, QC check samples, and blind field duplicates (Section 8.10.1). Acceptance criteria are given in the referenced method and in Tables 8-4 and 8-5.

If results for the QC check samples, laboratory duplicates, or blind field duplicates are outside the control limits, corrective action and/or data qualification requirements will be determined on a case-by-case basis by the QAC. The matrix of the QC check samples may not match the field sample matrix, and blind field duplication can be poor due to sample inhomogeneity. Therefore, corrective action will be determined by the QAC and discussed in the data QA report.

8.4.2 Representativeness

Representativeness expresses the degree to which data accurately and precisely represent an actual condition or characteristic of a population. Sample locations and field sampling procedures have been chosen to maximize representativeness. The degree of representativeness will be measured by repetitive measurements of the same parameter at the same sampling location over several distinct sampling events. The potential effect of seasonal variations and sampling on accuracy will also be considered with respect to representativeness.

8.4.3 Completeness

Completeness is a measure of the proportion of data specified in the sampling plan that is determined to be valid. The QA objective for completeness during this project will be 90 percent.

8.4.4 Comparability

Comparability is an expression of the confidence with which one data set can be compared to another. All measurements will be made so that results are consistent and representative of the media and conditions measured. All data will be calculated, qualified, and reported in units

consistent with EPA guidelines. Method detection limits and units to be reported are described in Section 8.8 of this document.

8.5 SAMPLING PROCEDURES AND HANDLING

8.5.1 Sampling Site Selection and Objectives

As previously discussed, groundwater and influent/effluent samples will be collected during the interim discharge activities. Groundwater samples will be collected from compliance monitoring wells and extraction wells located proximate to contaminant plumes. Monitoring well and extraction well locations are shown on Figure 8-2. Influent/effluent samples will be collected from the intake/discharge (respectively) of the treatment system.

Groundwater samples collected from compliance monitoring wells and extraction wells will be analyzed for a limited number of volatile organics to evaluate interception system performance and operational settings. Samples from groundwater compliance monitoring wells will be analyzed for the six volatile organic compounds identified as the Constituents of Concern (1,1,1-TCA; 1,1-DCA, 1,1-DCE; TCE; PCE, and methylene chloride) once a year, and will be analyzed for a reduced list of parameters identified as the indicator compounds (1,1,1-TCA; 1,1-DCA; 1,1-DCE; and TCE) for other sampling events each year. Samples collected from extraction wells will be analyzed for the Constituents of Concern for each sampling event.

Treatment system influent and effluent will be analyzed for volatile organic (full list of EPA Method 8010A compounds) to evaluate treatment system performance, and may be analyzed (at the County's discretion) for hardness and alkalinity to evaluate the effectiveness of scale control measures. Treatment system effluent samples will also be analyzed for NPDES parameters, including:

- Total phosphorous (as P)
- Semivolatile organics
- Organochlorine pesticides/PCBs
- Metals (total)
- Nitrogen, including nitrate, nitrite, ammonia, and total Kjeldahl nitrogen
- Chloride
- Chronic fish bioassays
- Algal growth potential.

Groundwater and treatment system influent/effluent samples will also be analyzed (in the field) for pH, specific conductivity, turbidity, and temperature.

8.5.2 Sampling Procedures

Sampling procedures are presented in the Field Sampling Plan (Appendix E to this O&M manual). Table 8-6 presents information on chemical analyses to be conducted, sample containers and sample preservation methods to be used, and maximum sample holding times.

8.5.3 Chain-of-Custody Procedures

Sample control and chain-of-custody procedures are addressed in Section 5.0.

8.5.4 Sample Documentation

Sample documentation will comply with procedures contained in Section 4.6 of *A Compendium of Superfund Field Operations Methods* (EPA 1987a). Project sampling and sample handling will be documented through the use of the records summarized in Table 8-7. Examples of forms to be used for sampling activities are presented in the Field Sampling Plan.

8.5.5 Laboratory Coordination and Reporting

The analytical laboratory will perform chemical analysis of groundwater samples. The Project Field Representative will coordinate sampling activity with the laboratory to assure that all samples can be processed within the required holding times. (Actual holding times will be verified by review during data validation as described in Section 8.9).

8.6 SAMPLE CUSTODY

Strict chain-of-custody procedures will be followed on the project to maximize sample integrity and accountability. Sample control and chain-of-custody in the field and during transport to the laboratory will be conducted in accordance with procedures described in Section 4.0 of *A Compendium of Superfund Field Operations Methods* (EPA 1987a) and Section 4.1.10 of Appendix A to this QAPP. For sample shipments, a chain-of-custody form similar to that presented in the Field Sampling Plan will be used. Sample control and custody at the laboratory through sample disposal will be conducted in accordance with procedures contained in the laboratory standard operation procedures (SOP) for organics and inorganics analysis.

When samples are transferred, the person relinquishing the samples will sign the Chain-of-Custody Form and record the date and time of transfer. The sample collector will sign the form in the first signature space.

Project documentation of sample custody will be verified by the QAC during regular review of the data validation package. Data validation is discussed further in Section 8.9.

8.7 CALIBRATION PROCEDURES AND FREQUENCY

8.7.1 Laboratory Instruments

Laboratory instruments will be calibrated and their performance evaluated in accordance with the methods cited in Section 8.12. Instrument performance for all other analyses will be evaluated against appropriate check standards and calibration blanks for each parameter prior to commencing actual analysis on each day the analysis is performed. Divergence from benchmark criteria (as defined in the above-cited methods) will be corrected prior to analysis.

For volatile organics analysis in water, the GC will be calibrated initially for each analyte with a 5-point calibration using concentrations established according to guidelines in the method. Linearity must be established by a variation of less than 20 percent RSD in the calibration factor throughout the working range. The calibration will be verified each day using one or more calibration standards, and must vary less than 15 percent from the initial calibration. Continuing calibration will be performed throughout the day using a mid-level standard and will vary less than 15 percent from the initial calibration factors. Retention time windows will be established for each analyte according to Method 8010A. These retention time windows will be updated daily according to the method and all continuing standards must fall within the windows.

Guidance for instrument calibration is described for individual methods for other organic and metal analytes in EPA 1986b and for other unorganic analyses in EPA 1983.

After calibration and standardization of instrumentation are within acceptable limits, precision and accuracy will be evaluated by analyzing a QC check sample for each analysis performed that day. QC check samples containing all analytes of interest will be either purchased commercially or prepared from pure standard materials independently from calibration standards. The QC check sample will be analyzed and evaluated according to criteria in the method. Instrument performance check standards and calibration blank results will be recorded in a laboratory log book, which will also contain evaluation parameters, benchmark criteria, and maintenance information (see Section 11.0). Table 8-8 presents suggested QC check

● materials for laboratory analysis and for field equipment measurement parameters not addressed in the methods cited above.

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8.7.2 Field Instruments

Four field instruments (pH meter, conductivity meter, thermometer, and turbidimeter) will be used during the interim discharge period. The field meters will be calibrated (if applicable) in accordance with manufacturer's instructions, which are presented in the Field Sampling Plan. QC limits for accuracy and precision of the field analyses are listed in Table 8-9.

Calibration results will be recorded in an instrument log book dedicated to each field instrument. This log book also will contain instrument preventive maintenance information, as appropriate.

8.8 ANALYTICAL PROCEDURES

The EPA methods have established detection limits (and, in some cases, quantification limits) covering each analyzed constituent for use nationwide as a contractual requirement for analytical laboratories. Quantification limits were established after considering typical ranges of interferences affecting quantification of constituents in representative environmental samples. Quantification of constituents at levels below the established quantification limits may be achieved if interferences are not significant. For highly contaminated samples, matrix effects may require higher quantification limits.

General methods and method quantification limits for analyses to be performed are summarized in Table 8-10. Methods for analysis will include analytical procedures, specified in Table 8-10, commonly employed by the project laboratory and verified as to accuracy and precision. QC checks and decision criteria for determining if an analysis is within laboratory and method QC requirements will follow the guidelines given in the laboratory SOP and/or QA plan or in the method, if available.

Where appropriate and consistent with anticipated data uses (and in recognition of the validation requirements), these procedures may be modified, with the concurrence of the QAC, to incorporate techniques familiar to the project laboratory. Deviations from EPA methods must be substantiated by full data verification and validation procedures, according to requirements presented in the *EPA 530/SW-87/008 Test Method Equivalency Petitions Manual* (EPA 1987e). Any such procedure deviations deemed significant by the QAC will be submitted to the EPA and Ecology for review and concurrence prior to implementation.

Three types of bioassays may be performed on discharge or receiving waters, chronic bioassay, acute bioassay, and algal growth potential tests. The bioassays will be performed according to protocols in *Short-Term Methods for Estimating the Chronic Toxicity of Effluents and*

Receiving Waters to Freshwater Organisms, EPA/600/4-89/001 and the Annual Book of ASTM Standards, Section 11, Water and Environmental Technology, Volume 11.04 Biological Effects and Environmental Fate. The testing will be conducted so as to determine the IC25 (the concentration providing a 25 percent inhibition of growth or reproduction in the test organisms), and a chronic NOEC. The testing will be conducted on the following organisms:

Freshwater chronic toxicity test species fathead minnow: *Pimephales promelas*

Chronic phytotoxicity test species alga: *Selenastrum capricornutum* as described in EPA/600/4-89/001.

A minimum of three replicates and a control will be run. If the test cannot statistically detect a 30 percent difference in toxic effect between the effluent dilution and the control, then the number of replicates will be increased in future tests until a 30 percent or less difference in toxic effect becomes statistically significant. The mean of these replicates will be compared to the control mean using the method in Appendix H or EPA/600/4-89/001 at the 0.05 level of significance.

8.9 DATA REDUCTION, VALIDATION, AND REPORTING

All analyses performed for the project must be accompanied by sufficient QC results to enable reviewers to conclusively determine the quality of the data. The QAC or designee is responsible to the Field Services Project Manager for conducting checks for internal consistency, transmittal errors, and laboratory protocols, and for complete adherence to the QC elements specified in this QAPP.

Field measurements (pH, conductivity, turbidity, and temperature) will be verified and checked through review of measurement and recording procedures during surveillance of field and instrumentation calibration procedures. Transfer of field data from field notebooks to raw data lists will be verified by the QAC.

Analytical data will be reported in the units specified in Table 8-10. These units have been selected to assure ease of comparison with previously generated relevant site data and human health criteria.

The laboratory will provide documentation including the sample results with appropriate annotations, and all QA/QC results associated with that sample set (method detection limits, blanks, laboratory duplicates, matrix spikes, matrix spike duplicates, laboratory control samples, and surrogate recoveries). Raw data will not be required for all samples; however, the

laboratory will maintain this information in their files. Data validation procedures for all samples will include checking the following:

- Holding times
- Field trip blanks
- Field rinsate blanks
- Field transfer blanks
- Blind field duplicates
- Laboratory duplicates
- Laboratory matrix spikes
- Laboratory matrix spike duplicates
- Method blanks
- Surrogate recoveries
- Detection limits
- Assessment of precision
- Assessment of accuracy
- Assessment of completeness.

Section 8.13 presents statistical tests used to determine data precision, accuracy, and completeness. If precision or accuracy fall outside established acceptance limits, reanalysis or corrective action will be implemented, as appropriate. Unless all corrective action is substantial and defensible, the corrected data will not be used. Corrective action procedures are presented in Section 8.14.

8.10 INTERNAL QUALITY CONTROL

QC checks will consist of measurements performed in the field and laboratory. Analytical procedures referenced in Section 8.8 specify routine methods required to evaluate whether data are within proper QC limits. Additional QC checks include analysis of a number of field and laboratory QC samples, which are described in the following subsections.

8.10.1 Field/Intralaboratory Methods

The following QC samples will be evaluated to verify accuracy and precision of analytical results for the project. The frequency of laboratory and field QC analyses is described herein.

8.10.1.1 Field Trip/Transfer Blank

The field trip/transfer blanks for water sampling will consist of deionized (DI) or distilled water in a volatile organic compound sample container (supplied by the analytical laboratory), which will be transported to the field, transferred to a new sample container in the field and returned to the laboratory for volatile organics analysis. One field trip/transfer blank will be included in each cooler containing water samples for volatile analysis.

8.10.1.2 Field Rinsate Blank

A minimum of 5 percent of the total number of non-QC groundwater samples collected using nondedicated sampling equipment will be collected and analyzed as field rinsate blanks. Field rinsate blanks will consist of DI or distilled water (supplied by the analytical laboratory) passed over and/or through decontaminated sampling equipment used to collect water samples. Surfaces and materials exposed during actual sampling will be rinsed to evaluate the effectiveness of sampling equipment decontamination procedures and potential for equipment or field cross-contamination.

8.10.1.3 Blind Field Duplicate

The field duplicate for groundwater sampling will consist of two water samples collected sequentially. Samples will be coded such that the laboratory cannot discern from the sample label which samples are duplicates. A minimum of 5 percent of the total number of non-QC water samples collected will be analyzed for all analyses as blind field duplicates to provide information on the precision of chemical analysis.

8.10.1.4 Laboratory Matrix Spike

Laboratory matrix spikes will be conducted to provide information on accuracy and assure that extraction and concentration levels are acceptable. These analyses will be conducted on a minimum of 5 percent of non-QC groundwater samples (or one per sampling event, if fewer than 20 samples are obtained). The laboratory matrix spike will follow matrix spike guide

lines specified in the laboratory SOP. Laboratory matrix spikes will be performed for all required chemical analyses.

8.10.1.5 Laboratory Matrix Spike Duplicate

Laboratory matrix spike duplicates will be analyzed for a minimum of 5 percent of non-QC water samples (or one per sampling event if fewer than 20 samples are obtained). These analyses will be performed to provide information on the precision of chemical analysis. The laboratory matrix spike duplicate will follow matrix spike duplicate guidelines specified in the laboratory SOP. Laboratory matrix spike duplicates will be performed for all required organic analyses.

8.10.1.6 Laboratory Duplicates

Laboratory duplicates will be conducted on a minimum of 5 percent of all non-QC water samples to provide information on the precision of chemical analysis. Laboratory duplicates will be analyzed for all inorganic analyses.

8.10.1.7 Laboratory Method Blank

Laboratory method blanks will be analyzed for all analyses for a minimum of 5 percent of all non-QC water samples (or one per batch of samples analyzed, if fewer than 20 samples are analyzed) to assess possible laboratory contamination. Dilution water will be used whenever possible. Laboratory method blanks will contain all reagents used for analysis.

8.10.1.8 QC Check Sample

QC check samples containing each analyte of interest will be analyzed for a minimum of 5 percent of non-QC water samples (or one per sampling event if fewer than 20 samples are obtained) to verify the accuracy of laboratory equipment. Analysis will follow guidelines established in the EPA methods. Procedure calibrations will substitute for QC check samples where QC check samples are not required by the method.

8.10.2 Interlaboratory Comparisons

Interlaboratory comparisons are not planned at this time. A limited number of samples may be split with the EPA and/or Ecology, if requested.

8.11 PERFORMANCE AND SYSTEM AUDITS

This section presents the internal performance and systems audits required to monitor performance of the laboratory and field measurement systems. Performance and system audits of sampling activities and laboratory operations will consist of direct observations of work being performed, and inspection of laboratory and field equipment use, calibration, and maintenance to verify adherence to QA/QC requirements.

Internal audits of both field and laboratory activities will be conducted by the QAC or designee once within the first 6 months of operation, and once every 2 years thereafter. Field audits will be unannounced to assure representative performance of technical and QA procedures. Laboratory audits will be scheduled to assure that project samples are being analyzed during the audit.

Checklists for both field and laboratory audits will be based on EPA's National Enforcement Investigation Center audit checklists (EPA 1984b) as presented in Forms 8-2 through 8-6 to this section. The audit will be conducted only by individuals that have no direct responsibilities for the activities being audited.

Prior to internal audits, the auditor(s) will meet with the audited party to define the scope of the audit. The physical audit will consist of reviewing audited activities, completing the checklist, and noting any nonconformances, deficiencies, and relevant observations. An exit review will be conducted with the audited party to notify them of preliminary audit findings.

The auditor or designee will prepare an audit report that includes findings, nonconformances, observations, recommended corrective action, and a schedule for completion of such action. An Audit Report Format similar to that presented in Table 8-11 will be used.

For each identified nonconformance, a Corrective Action Report (Form 8-1) will be issued as part of the audit report by the auditor to notify the responsible party (the individual responsible for implementing corrective action) of the recommended corrective action and its schedule for completion (see Section 8.14). If a field corrective action is required, the Field Coordinator will be notified. If a laboratory corrective action is required, the Laboratory QA Officer will be notified. The audit report will be distributed to the Spokane County Project Manager and Field Services Project Manager.

The audit will remain open until all corrective action is completed by the responsible party and approved by the QAC. Once all findings are corrected and documented on Corrective Action Reports, the audit will be closed by the QAC. Closure may be effected by either a memo to be filed with the audit report or by another appropriate method. The audit reports and

associated Corrective Action Reports will be submitted to Ecology and EPA once the audit is closed.

8.12 PREVENTIVE MAINTENANCE

8.12.1 Field Instruments

The field representative is responsible for field instrumentation preventive maintenance for instrumentation utilized by that individual. Preventive maintenance on field instruments will be performed by qualified field technicians in accordance with manufacturer's instructions and maintenance schedules. Maintenance will be documented in instrument log books and will include the date and initials of the individual performing the maintenance.

The field representative will routinely compare instrument calibration results against preventive maintenance records to verify the effectiveness of the preventive maintenance program. The field representative is responsible for scheduling preventive maintenance required by the manufacturer.

8.12.2 Laboratory Instruments

The analytical laboratory manager has ultimate responsibility for maintaining laboratory instruments in good working order, including responsibilities for routine maintenance and the training of personnel in maintenance procedures. All maintenance activities and other appropriate details will be documented daily in maintenance log books by the laboratory personnel performing the maintenance. Each entry will be signed and dated. At a minimum, the preventative maintenance schedules contained in the equipment manufacturer's instructions will be followed.

8.13 SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA

Analytical data will be reviewed to assure that the QA/QC objectives for precision, accuracy, and completeness are met. These reviews are intended to identify the occurrence of deficiencies in time to take corrective action. This section describes routine procedures for assessing project data.

8.13.1 Assessment of Precision

Precision measures the mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. QA/QC sample types that test precision

include field duplicates, laboratory duplicates, and laboratory matrix spike duplicates. The estimate of precision of duplicate measurements is expressed as a relative percent difference (RPD), and is calculated as follows:

$$RPD = \frac{D_1 - D_2}{(D_1 + D_2)/2} \times 100$$

Where D_1 = First sample value

D_2 = Second sample value (duplicate)

The RPDs will be routinely calculated and compared with DQOs.

To set control limits, the standard deviation, s , of a series of replicate measurement limits is calculated:

$$s = \sqrt{\sum_{i=1}^n \frac{(X_i - \bar{X})^2}{n-1}}$$

Where: s = the sample standard deviation

n = the number of replicates

X_i = the i th replicate

\bar{X} = the mean of the replicates

8.13.2 Assessment of Accuracy

Accuracy is assessed using results of QC check samples and laboratory matrix spike analyses, and is routinely expressed as a percent recovery, which is calculated:

$$\text{Percent Recovery} = \frac{(\text{Total Analyte Found} - \text{Analyte Originally Present}) \times 100}{\text{Analyte Added}}$$

The percent recovery will be routinely calculated and checked against DQOs.

8.13.3 Assessment of Completeness

The amount of valid data produced will be compared with the total analyses performed to assess the percent of completeness. Completeness will be routinely calculated and compared with DQOs.

8.14 CORRECTIVE ACTIONS

Corrective actions may be needed for three categories of non-conformance:

- Deviations from the methods or QA requirements established in the QAPP
- Measuring or analytical equipment malfunctions
- Analytical error.

Corrective action procedures that might be implemented based on audit results; detection of unacceptable data are developed on a case-by-case basis. Such actions may include one or more of the following:

- Altering procedures in the field
- Using a different batch of containers
- Performing an additional audit of field or laboratory procedures
- Reanalyzing samples if holding times allow
- Resampling and analyzing
- Evaluating sampling and analytical procedures to determine possible causes of the discrepancies
- Accepting the data with no action, while acknowledging the level of uncertainty
- Rejecting the data as unusable.

During field operations and sampling procedures, the field representative will be responsible for taking and reporting required corrective action related to field activities. A description of any such action taken will be entered in the Field Log Book. If field conditions are such that conformance with the QAPP is not possible, the QAC will be consulted immediately. Any corrective action or field condition resulting in a major revision of the QAPP or Field Sampling Plan will be communicated to the County Project Manager, as well as the EPA and Ecology, for review and concurrence. This communication will be made prior to changes in the field activities whenever possible.

During laboratory analysis, the Laboratory QA Officer will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet DQOs outlined in this QAPP, corrective action will follow the guidelines in the EPA methods

and the EPA guidelines for data validation for organics and inorganics (EPA 1988a,b; EPA 1991).

At a minimum, the Laboratory QA Officer will be responsible for monitoring the following:

- Calibration check compounds must be within performance criteria specified in the EPA method or corrective action must be taken prior to initiation of sample analysis. For volatile organics analysis in water (Method 8010A), a minimum of five calibration standards will be prepared for each analyte of interest. One of the standards should be at a concentration near, but above, the method quantification limit. The other concentrations should correspond to the expected range of concentrations found in real samples or should define the working range of the detector. The percent relative standard deviation cannot exceed 20 percent when comparing calibration factors to determine if the five-point calibration curve is linear. The working calibration curve or calibration factor must be verified on each working day by the injection of one or more calibration standards. If the response for any analyte varies from the predicted response by more than ± 15 percent, a new calibration curve must be prepared for that analyte. No analyses may be performed until these criteria are met.
- Before processing any samples, the analyst should demonstrate, through analysis of a reagent blank, that interferences from the analytical system, glassware, and reagents are within acceptable limits. Each time a set of samples is extracted or there is a change in reagents, a reagent water blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.

For volatile organics analysis in water, blanks must contain less than 1.0 $\mu\text{g/L}$ methylene chloride. The laboratory should report the methylene chloride concentration as estimated, "J," at the detected value, if below the 1.0 $\mu\text{g/L}$ limit. For other parameters, method blanks must be below criteria guidelines specified in the method. If contaminants are present above these levels, the source of contamination must be investigated, corrective action taken and documented, and all samples associated with a contaminated blank re-analyzed. If, upon re-analysis, blanks do not meet these requirements, the QAC will be notified immediately to discuss whether analyses may proceed.

- Retention time windows will be defined by plus or minus three times the standard deviation of the absolute retention times for each standard. The laboratory must calculate retention time windows for each standard on each GC column and whenever a new GC column is installed. The data must be retained by the laboratory. All succeeding standards in an analysis sequence must fall within the daily retention time window established by the first standard of the sequence. No analyses may proceed until this criterion is met.
- Matrix spike analysis for volatile organics must be within the specified range for recovery limits, or corrective action must be taken and documented. Corrective action includes: 1) reviewing calculations, 2) checking surrogate solutions, 3) checking internal standards, and 4) checking instrument performance. Subsequent action could include recalculating the data and/or

re-analyzing the sample if any of the above checks reveal a problem. If the problem cannot be corrected through re-analysis, the QAC will be notified by the laboratory prior to data submittal, so that additional corrective action can be taken, if appropriate.

If the recovery of a surrogate compound in the method blank is outside the recovery limits, the blank will be re-analyzed along with all samples associated with that blank. If the surrogate recovery is still outside the limits, the QAC will be notified immediately to discuss whether analyses may proceed.

- If holding times are exceeded, all positive and non-detected results will be qualified as estimated concentrations. If holding times are grossly exceeded, the QAC may determine the data to be unusable.
- If laboratory instrumentation deviates from required calibration specifications, the QAC will either flag data as estimated or determine it to be unusable, according to guidelines established by EPA (EPA 1988a,b, 1991).

If analytical conditions are such that non-conformance with this QAPP is indicated, the QAC will be notified as soon as possible, so that any additional corrective actions can be taken.

Corrective Action Reports (Form 8-1) will be used to document response to reported nonconformances. These reports may be generated from internal or external audits or from informal reviews of project activities (Section 8.11).

Corrective Action Reports initially will be reviewed for appropriateness of recommendations and actions by the QAC (for QA matters) and by the Project Manager (for technical approach). The reports will then be forwarded to the County Project Manager for review.

8.15 QUALITY ASSURANCE REPORTS TO MANAGEMENT

All data packages submitted to the EPA and Ecology will include a QA report containing results of the QA workups and conclusions. This QA report will summarize all relevant data quality information. The QAC will be responsible for data quality assessments and associated QA reports.

QA audit reports will be prepared and submitted to the Project Manager, the County Project Manager, and EPA. Final task or investigative reports will contain a separate QA section summarizing data quality information.

8.16 REFERENCES

APHA-AWWA-WPCF. 1985. *Standard Methods for the Examination of Waste and Wastewater*. 16th Edition.

EPA. 1979. *Handbook for Analytical Quality Control in Water and Wastewater Laboratories*. U.S. Environmental Protection Agency 600/4-79-019.

EPA. 1981. *NEIC Manual for Groundwater/Subsurface Investigations at Hazardous Waste Sites*. U.S. Environmental Protection Agency 330/9-81-002.

EPA. 1982. *Handbook for Sampling and Sample Preservation of Water and Wastewater*. U.S. Environmental Protection Agency 600/4-82-029.

EPA. 1983. *Methods for Chemical Analysis of Water and Wastes*. U.S. Environmental Protection Agency.

EPA. 1984a. *Characterization of Hazardous Waste Sites—A Methods Manual: Volume II. Available Sampling Methods*. Second Edition. U.S. Environmental Protection Agency 600/4-84-076.

EPA. 1984b. *NEIC Procedures Manual for the Evidence Audit of Enforcement Investigations by Contractor Evidence Audit Teams*. U.S. Environmental Protection Agency 330/9-81-003-R).

EPA. 1986a. *The Quality Assurance Manual for Waste Management Branch Investigations*. U.S. Environmental Protection Agency, Region X.

EPA. 1986b. *Test Methods for Evaluating Solid Waste (SW 846)*. Third Edition. U.S. Environmental Protection Agency.

EPA. 1987a. *A Compendium of Superfund Field Operations Methods*. U.S. Environmental Protection Agency 540/P-87/001.

EPA. 1987b. *Record of Decision, Decision Summary, and Responsiveness Summary for Interim Final Remedial Action, Colbert Landfill Site, Colbert, Washington*. U.S. Environmental Protection Agency. September.

EPA. 1987c. *Data Quality Objectives for Remedial Response Activities*. U.S. Environmental Protection Agency 540/6-87/003.

EPA. 1987d. *Statement of Work for Inorganic Analysis, Multi-Media, Multi-Concentration*. U.S. Environmental Protection Agency, Contract Laboratory Program.

EPA. 1987e. *Test Method Equivalency Petitions Manual*. U.S. Environmental Protection Agency 530/SW-87/008.

EPA. 1988a. *Laboratory Data Validation, Functional Guidelines for Evaluating Inorganics Analysis*. U.S. Environmental Protection Agency, Hazardous Site Evaluation Division.

EPA. 1988b. *Laboratory Data Validation, Functional Guidelines for Evaluating Organics Analysis*. U.S. Environmental Protection Agency, Hazardous Site Evaluation Division.

EPA. 1990. *Statement of Work for Organic Analysis, Multi-Media, Multi-Concentration*. U.S. Environmental Protection Agency, Contract Laboratory Program.

EPA. 1991. *National Functional Guidelines for Organic Data Review, Multi-Media, Multi-Concentration, and Low Concentration Water Draft*. U.S. Environmental Protection Agency Contract Laboratory Program.

Golder Associates, Inc. 1987. *Remedial Investigation and Feasibility Study*. May.

Landau Associates, Inc. 1987. *QAPjP Phase I*.

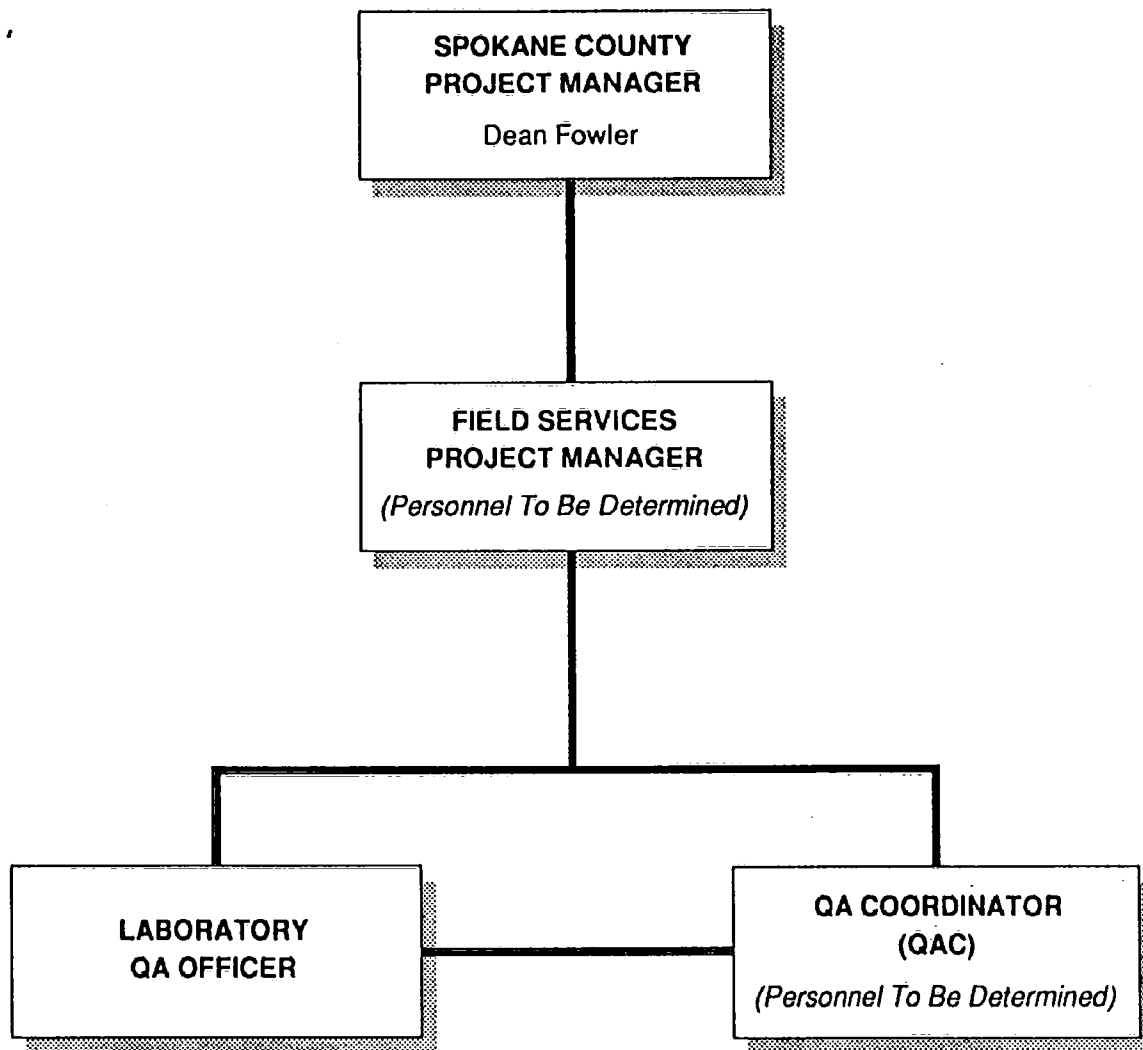
Landau Associates, Inc. 1989. *Quality Assurance Project Plan, Colbert Landfill Remedial Design/Remedial Action*. Prepared for Spokane County Utilities Department, Spokane, Washington. 28 September 1989.

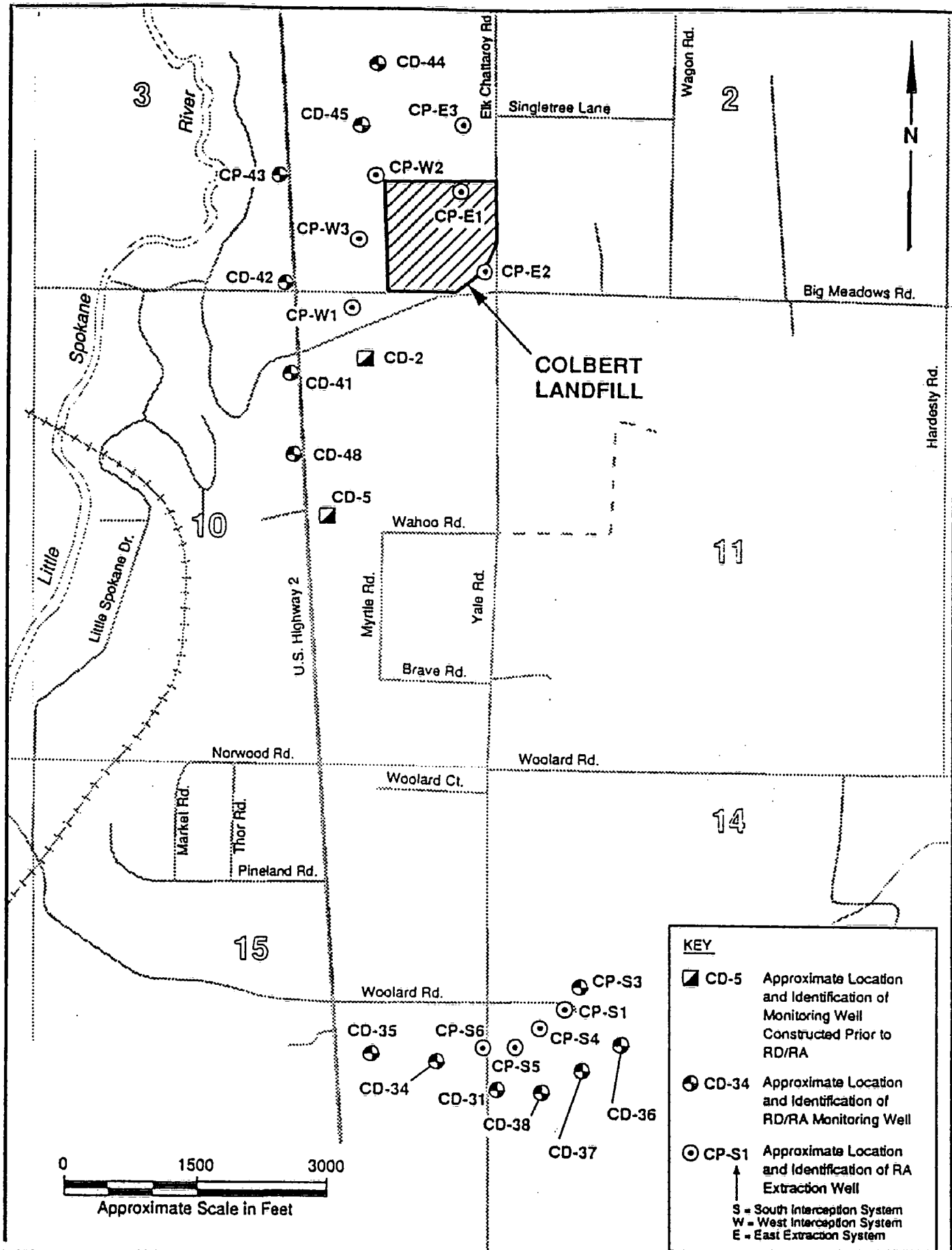
Landau Associates, Inc. 1991. *Final Phase I Engineering Report, Colbert Landfill Remedial Design/Remedial Action, Spokane County, Washington*. December 30.

NIOSH. 1988. *Manual of Analytical Methods*. National Institute for Occupational Safety and Health. July 6, 1988.

National Oceanic and Atmospheric Administration (NOAA). 1985. *Summary of Day-First Order TD3210, Entire Period of Record through 1985 for Spokane, Washington*. U.S. Department of Commerce, National Oceanic and Atmospheric Administration, National Environmental Satellite Data and Information Service, National Climatic Data Center, Asheville, North Carolina.

U.S. District Court, Eastern District of Washington. 1988. Consent Decree No. C-89-033-RJM. 28 February 1988.





Extraction and Compliance Monitoring Well Location Map

Figure 8-2

Corrective Action Report

Sample Program Identification: _____

Sampling Dates: _____

Material to be Sampled: _____

Measurement Parameter: _____

Acceptable Data Range: _____

Corrective Actions Initiated By: _____

Title: _____ Date: _____

Problem Areas Requiring Corrective Action: _____

Measures to Correct Problems: _____

Means of Detecting Problems (field observations, systems audit, etc.) _____

Approval for Corrective Actions: _____

Title: _____ Date: _____

Signature: _____

DRAFT

FIELD CHECKLIST

Field Observations

- Yes__ No__ N/A__ 1. Was permission granted to enter and inspect the facility?
(Required if RCRA inspection.)

- Yes__ No__ N/A__ 2. Is permission to enter the facility documented? If yes, where is
it documented?

- Yes__ No__ N/A__ 3. Were split samples offered to the facility? If yes, was the offer
accepted or declined?

- Yes__ No__ N/A__ 4. Is the offering of split samples recorded? If yes, where is it
recorded?

- Yes__ No__ N/A__ 5. If the offer to split samples was accepted, were the split
samples collected? If yes, how were they identified?

- Yes__ No__ N/A__ 6. Are the number, frequency, and types of field measurements
and observations taken as specified in the project plan or as
directed by the project coordinator? If yes, where are they
recorded?

Yes__ No__ N/A__ 7.

Are samples collected in the types of containers specified for each type of analysis? If no, what kind of sample containers were used?

Yes__ No__ N/A__ 8.

Are samples preserved as required? If no or N/A, explain.

Yes__ No__ N/A__ 9.

Are the number, frequency, and types of samples collected as specified in the project plan or as directed by the project coordinator? If no, explain why not.

Yes__ No__ N/A__ 10.

Are samples packed for preservation when required (i.e., packed in ice, etc.)? If no or N/A, explain why.

Yes__ No__ N/A__ 11.

Is sample custody maintained at all times? How?

FIELD CHECKLIST

Document Control

Yes__ No__ N/A__ 1. Have all unused and voided accountable documents been returned to the coordinator by the team members?

Yes__ No__ N/A__ 2. Were any accountable documents lost or destroyed? If yes, have document numbers of all lost or destroyed accountable documents been recorded, and where are they recorded?

Yes__ No__ N/A__ 3. Are all samples identified with sample tags? If no, how are samples identified?

Yes__ No__ N/A__ 4. Are all sample tags completed (e.g., station no., location, date, time, analyses, signatures of samplers, type, preservatives, etc.)? If yes, describe types of information recorded.

Yes__ No__ N/A__ 5. Are all samples collected listed on a chain-of-custody record? If yes, describe the type of chain-of-custody record used and what information is recorded.

Yes__ No__ N/A__ 6. If used, are the sample tag numbers recorded on the chain-of-custody documents?

Yes__ No__ N/A__

7.

Does information on sample tags and chain-of-custody records match?

Yes__ No__ N/A__

8.

Does the chain-of-custody record indicate the method of sample shipment?

Yes__ No__ N/A__

9.

Is the chain-of-custody record included with the samples in the shipping container?

Yes__ No__ N/A__

10.

If used, do the sample traffic reports agree with the sample tags?

Yes__ No__ N/A__

11.

If required, has a receipt for the samples been provided to the facility (required by RCRA)? Describe where offer of a receipt is documented.

Yes__ No__ N/A__

12.

If used, are blank samples identified?

Yes__ No__ N/A__

13.

If collected, are duplicate samples identified on sample tags and chain-of-custody records?

- Yes__ No__ N/A__ 14. If used, are spiked samples identified?

- Yes__ No__ N/A__ 15. Are logbooks signed by the individual who checked out the logbook from the project coordinator?

- Yes__ No__ N/A__ 16. Are logbooks dated upon receipt from the project coordinator?

- Yes__ No__ N/A__ 17. Are logbooks project-specific (by logbook or by page)?

- Yes__ No__ N/A__ 18. Are logbook entries dated and identified by author?

- Yes__ No__ N/A__ 19. Is the facility's approval or disapproval to take photographs noted in a logbook?

- Yes__ No__ N/A__ 20. Are photographs documented in logbooks (e.g., time, date, description of subject, photographer, etc.)?

- Yes__ No__ N/A__ 21. If film from a self-developing camera is used, are photos matched with logbook documentation?

Yes__ No__ N/A__ 22.

Are sample tag numbers recorded? If yes, describe where they are recorded.

Yes__ No__ N/A__ 23.

Are calibration of pH meters, conductivity meters, etc., documented? If yes, describe where this is documented.

Yes__ No__ N/A__ 24.

Are amendments to the project plan documented? If yes, describe where the amendments are documented.

DRAFT

Debriefing with Project Coordinator

Was a debriefing held with project coordinator and/or other participants?

Were any recommendations made to the project participants during the debriefing? If yes, list recommendations.

LABORATORY CHECKLIST

SIGNATURE OF AUDITOR _____ DATE OF AUDIT _____
LABORATORY _____ CEAT PROJECT NO. _____
LABORATORY LOCATION _____
CONTRACTS IN EFFECT _____

(List Contract Numbers)

1. Name of Sample Custodian and other personnel responsible for sample receipt and document control.

2. Where are the Sample Custodian's procedures and responsibilities documented?

3. Where are written Standard Operating Procedures (SOPs) pertaining to receipt of samples documented (laboratory manual, written instructions, etc.)?

4. Where is the receipt of chain-of-custody record(s) with samples being documented?

5. Review sample receipt documentation to assure that the nonreceipt of chain-of-custody record(s) with samples is being documented.

6. Where is the integrity of the shipping container(s) being documented [custody seal(s) intact, container locked or sealed properly, etc.]?

7. Review the sample documentation to assure that the lack of integrity of the shipping container(s) is being documented (i.e., evidence of tampering, custody seals broken or damaged, locks unlocked or missing, etc.).

8. Determine, by asking the Sample Custodian or reviewing the laboratory SOP manual, if agreement among Sample Management Office forms, chain-of-custody records, and sample tags is being verified? State source of information.

9. Where is the agreement or nonagreement verification being documented?

10. Review sample receipt documentation to assure that sample tag numbers are recorded by the Sample Custodian.

11. Where are written Standard Operating Procedures (SOPs) pertaining to the sample storage documented (laboratory manual, written instructions, etc.)?

- 12a. Do written SOPs and actual laboratory practices demonstrate laboratory security?

- 12b. Describe sample storage area (upright refrigerator in GC lab, walk-in cooler in sample receiving area, etc.).

13. How is sample identification maintained?

14. How is sample extract (or inorganics concentrate) identification maintained?

15. How are samples that require preservation stored to maintain their preservation?

16. How are written Standard Operating Procedures (SOPs) pertaining to sample handling and tracking documented?
17. What laboratory records are used to record personnel receiving and transferring samples in the laboratory?
18. Affirm that each instrument used for sample analysis (GC, GC/MS, AA, etc.) has an instrument log. List those instruments which do not.
19. Determine where analytical methods are documented and ask if methods are available to the analysts.
20. Determine where quality assurance procedures are documented and ask if procedures are available to the analysts.
21. How are written Standard Operating Procedures (SOPs) for compiling and maintaining sample document files documented?
22. How are sample documents filed (by case number, internal laboratory number, batch number, sample number, etc.)?
23. Review sample document files to determine if a document file inventory is prepared for each case file.

24. Review sample document files to determine if all documents in the case files are consecutively numbered according to the file inventories.

25. Observe the document file storage area to determine if the laboratory document files are stored in a secure area.

26. Has the laboratory received any confidential documents?

Complete questions 27, 28, and 29 ONLY if the response to question 26 was yes.

27. Review the case files to assure that confidential documents are segregated from other laboratory documents.

28. Review the case files to assure that confidential documents are stored in a secure manner.

29. Review recommendations from the previous audit to determine if the recommendations have been implemented. If not, the recommendations should be repeated and the laboratory director and the Project Officer should be notified.

LABORATORY CHECKLIST

Debriefing with Laboratory Personnel

1. List observations made by the auditor.

2. Make recommendations with respect to each observation.

3. Discuss observations and recommendations made by the auditor.

TABLE 8-1

CONSENT DECREE WATER QUALITY CRITERIA^(a)

Constituent of Concern	Performance Standard	Evaluation Criteria
1,1,1-Trichloroethane	200	200
Trichloroethylene	5	5
1,1-Dichloroethane	4,050	4,050
1,1-Dichloroethylene	7	7
Methylene chloride	2.5	25
Tetrachloroethylene	0.7	7

(a) Concentration in parts per billion ($\mu\text{g/L}$).

TABLE 8-2
NPDES INTERIM EFFLUENT LIMITATIONS

Parameter	Daily Average	Daily Maximum
Flow	Continuous	
Chloride	230 mg/L	
1,1-Dichloroethane		4,050 µg/L
1,1-Dichloroethylene		7 µg/L
Iron	300 µg/L	
Manganese	50 µg/L	
Methylene chloride		2.5 - 25 ^(a) µg/L
Nitrates	10 mg/L	
pH		8.5
Total phosphorus		930 µg/L
Tetrachloroethylene		0.7 - 7 ^(a) µg/L
1,1,1-Trichloroethane		200 µg/L
Trichloroethylene		5 µg/L

(a) The daily maximum will be determined as a result of the removal efficiency of the system. These figures are part of the evaluation and performance criteria in the Consent Decree.

TABLE 8-3

QUALITY ASSURANCE RESPONSIBILITIES

Personnel	Responsibilities
Field Services Project Manager	Coordinate technical Project direction and product technical review; coordinate project/agency interaction; review project QA needs and approve appropriate QA corrective actions as needed; oversee technical project team performance to ensure successful accomplishment of technical and QA project objectives.
Project QA Coordinator (QAC)	Provide technical QA assistance; direct implementation of QAPP; arrange contract or other external procurement packages for QA needs; prepare corrective action response; prepare and submit QA reports to project management; conduct or supervise laboratory and field audits.
Laboratory QA Officer	Ensure that all laboratory QA objectives are met and laboratory QA/QC information is properly documented and reported.

TABLE 8-4

SURROGATE RECOVERY CONTROL LIMITS
IN WATER SAMPLES

Surrogate Name	Control Limits (percent) ^(a)
Volatile Organics (8010A)	
Bromofluorobenzene	67 - 130
Bromochloromethane	62 - 138
Semivolatile Organics (8270A)	
Nitrobenzene-d5	35 - 114
2-Fluorobiphenyl	43 - 116
p-Terphenyl-d14	33 - 141
Phenol-d5	10 - 94
2-Fluorophenol	21 - 110
2,4,6-Tribromophenol	10 - 123
d14-1,2-Dichlorobenzene	16 - 110
Organochlorine Pesticides/PCBs (8081)	
TCMX	26 - 93
DCBP	31 - 111

(a) Surrogate selection and control limits may be revised after selection of analytical laboratory.

TABLE 8-5

LABORATORY MATRIX SPIKE/MATRIX SPIKE DUPLICATE CONTROL LIMITS
IN WATER SAMPLES

	Recovery (percent)	RPD ^(a) (percent)
<u>Volatile Organics Analyses (8010A)</u>		
1,1-Dichloroethylene	61-145	20
Trichloroethylene	71-120	20
1,1,1-Trichloroethane	20-160	50
1,1-Dichloroethane	20-160	50
Methylene chloride	20-160	50
Tetrachloroethylene	20-160	50
<u>Semivolatile Organics (8270A)</u>		
1,2,4-Trichlorobenzene	39-98	28
Acenaphthene	46-118	31
2,4-Dinitrotoluene	24-96	38
Pyrene	26-127	31
N-Nitrosodi-n-propylamine	41-116	38
1,4-Dichlorobenzene	36-97	28
Pentachlorophenol	9-103	50
Phenol	12-110	42
2-Chlorophenol	27-123	40
4-Chloro-3-methylphenol	23-97	42
4-Nitrophenol	10-80	50
<u>Organochlorine Pesticides/PCB (8081)</u>		
Lindane	56-123	15
Heptachlor	40-131	20
Aldrin	40-120	22
Dieldrin	52-126	18
Endrin	56-121	21
4,4'-DDT	38-127	27
Aroclor 1242	50-120	25

LABORATORY MATRIX SPIKE/MATRIX SPIKE DUPLICATE CONTROL LIMITS
IN WATER SAMPLES

	Recovery (percent)	RPD ^(a) (percent)
<u>Metals</u> (6010/7000)	75-125	20
<u>Other Inorganics</u>		
Chloride, nitrate, nitrite, ammonia, total phosphorus	75-125	20
<u>Other</u>		
Hardness	NA ^(b)	20
Alkalinity	75-125	20

(a) RPD = Relative percent difference.

(b) Replicate samples are substituted for matrix spike/matrix spike duplicate.

TABLE 8-6

WATER SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

	Analysis	Sample Container ^(a)	Preservation	Holding ^(b) Time
Groundwater	Volatile Organics	2 each - 40 mL glass vials (leave no headspace), Teflon-lined septum cap	Maintain on ice HCl to pH <2	14 days
Influent/ Effluent	Hardness	4-oz plastic	HNO ₃ to pH <2	6 months
	Alkalinity	4-oz plastic	None	14 days
	Semivolatile Organics	3 each - 1-L amber glass; Teflon-lined cap	Cool to 4°C	7 days to extraction; 40 days after extraction
	Organochlorine Pesticides/PCBs	3 each - 1 L amber glass; Teflon-lined cap	Cool to 4°C; pH 5-9	7 days to extraction; 40 days after extraction
	Metals			
	Mercury	1-L polyethylene	HNO ₃ to pH <2	28 days
	Other metals ^(c)	1-L polyethylene	HNO ₃ to pH <2	6 months
	Other Inorganics			
	Chloride, Nitrate, Nitrite	1-L polyethylene	Cool to 4°C	28 days, 48 days, 48 hours
	Ammonia, total Kjeldahl nitrogen, total phosphorus	1-L polyethylene	Cool to 4°C H ₂ SO ₄ to pH <2	28 days

WATER SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Analysis	Sample Container ^(a)	Preservation	Holding ^(b) Time
Chronic bioassay	3 each - 2-1/2 gallon plastic cubiliter containers ^(d)	Cool to 4°C	36 hours
Algal growth potential	2 each - 1 L amber glass; Teflon-lined cap	Cool to 4°C	36 hours

- (a) Sample container specifications may be modified after consultation with the analytical laboratory. Where composite samples of influent/effluent are collected, 3-gallon polyethylene cubitainers will be used.
- (b) Holding times are from date of collection. All samples will be shipped to the laboratory within 24 hours (except as noted for samples collected on Friday). Arrangements will be made with the laboratory for timely receipt of samples with short holding times.
- (c) Other metals include antimony, arsenic, beryllium, cadmium, chromium, copper, iron, lead, manganese, nickel, selenium, silver, thallium, and zinc.
- (d) One container shipped each on Wednesday, Friday, and Monday.

TABLE 8-7

SAMPLING AND SAMPLE HANDLING RECORDS

Record	Use	Responsibility/Requirements
Field Log Book	Record significant events, observations, and measurements.	Maintained by sample collector; must be bound; all entries factual, detailed, and objective; entries must be signed and dated.
Sample Collection Form	Provide a record of each sample collected (Appendix B).	Completed, dated, and initialed by sample collector; maintained in project file.
Sample Label	Accompanies sample; contains specific sample identification information.	Attached to sample container by analytical laboratory and completed by sampler.
Chain-of-Custody Seal	Seals sample shipment container to prevent tampering or sample transference (Appendix B).	Completed, signed, and applied by sample collector at time samples are transported.
Chain-of-Custody Record	Accompanies samples, provides record of responsibility for custody from field to disposal of sample.	Completed and signed by sample collector before relinquishing custody; must be signed by person accepting custody; must accompany samples at all times.
Sample Analysis Request Packing List	Provides a record of each sample number, date of collection/transport, sample matrix, analytical parameters for which samples are to be analyzed, and condition of samples on receipt at laboratory (Appendix B).	Completed by sample collector at time of sampling transport; carbonless copies distributed to laboratory (copy 2) and project file (copy 1).

TABLE 8-8

INSTRUMENT PERFORMANCE CHECK MATERIALS AND FREQUENCY

Parameter	Check Material ^(a)	Frequency
<u>Laboratory Analysis</u>		
Chloride	Commercially prepared ^(b) standard solution	Daily or every 20 samples ^(c)
Nitrate	Commercially prepared standard solution	Daily or every 20 samples
Nitrite	Commercially prepared standard solution	Daily or every 20 samples
Ammonia	Commercially prepared standard solution	Daily or every 20 samples
Total Kjeldahl nitrogen	Standardized cuvettes	Once per year
Hardness	Commercially prepared standard solution	Daily or every 20 samples
Alkalinity	NA	NA
Total phosphorus	Standardized cuvettes	Once per year
<u>Field Measurement</u>		
pH (meter)	pH 4, 7, 10 standard buffer solution	Minimum of every 4 hours of field use
Conductivity	KCl standard solution	Minimum of every 4 hours of field use
Temperature	National Bureau of Standards thermometer	Minimum of every 6 months
Turbidity		Minimum of every 4 hours of field use

- (a) Check materials are subject to change based on actual preliminary instrument qualifying results.
- (b) Standard solution may also be prepared by the laboratory independently from calibration solutions.
- (c) Whichever is greater; daily is defined as every day the analysis is performed.

TABLE 8-9

FIELD ANALYSIS QUALITY CONTROL LIMITS

Parameter	Units	Accuracy	Precision
pH unit	Standard pH units	± 0.1 pH unit	± 0.1 pH unit
Specific conductivity	umhos/cm	$\pm 5\%$	$\pm 5\%$
Temperature	$^{\circ}\text{C}$	$\pm 0.1^{\circ}\text{C}$	$\pm 0.1^{\circ}\text{C}$
Turbidity	NTU	$\pm 5\%$	$\pm 5\%$

METHODS AND QUANTIFICATION LIMITS FOR
ANALYSIS OF GROUNDWATER

Analyte	Technique	Analysis Method	Quantification Limit
<u>Volatile Organics</u>	GC/HSD	EPA 8010A ^(a)	(µg/L)
Dichlorodifluoromethane			--
Chloromethane			0.8
Vinyl chloride			1.8
Bromomethane			3.0
Chloroethane			5.2
Trichlorofluoromethane			--
1,1-Dichloroethylene ^(b)			1.3
Methylene chloride ^(b)			2.5
trans-1,2-Dichloroethylene			1.0
1,1-Dichloroethane ^(b)			0.7
Chloroform			0.5
1,1,1-Trichloroethane ^(b)			0.3
Carbon tetrachloride			1.2
1,2-Dichloroethane			0.3
Trichloroethylene ^(b)			1.2
1,2-Dichloropropane			0.4
Bromodichloromethane			1.0
trans-1,3-Dichloropropylene			3.4
1,1,2-Trichloroethane			0.2
Tetrachloroethylene ^(b)			0.3
Chlorodibromomethane			0.9
Chlorobenzene			2.5
Bromoform			2.0
1,1,2,2-Tetrachloroethane			0.3
1,3-Dichlorobenzene			3.2
1,4-Dichlorobenzene			2.4
1,2-Dichlorobenzene			1.5
Benzyl chloride			--
Bromobenzene			--
2-Chloroethyl vinyl ether			1.3
Dibromomethane			--
1,1,1,2-Tetrachloroethane			--
Trichloropropane			--
<u>Semivolatile Organics</u>	GC/MS	EPA 8270A	(µg/L)
Acenaphthene			10.0
Benzidine			N/A ^(c)
Chlorinated benzenes			N/A
Chlorinated naphthalenes			N/A
bis(2-Chloroethyl)ether			10.0
bis(2-Chloroisopropyl)ether			10.0
bis(2-Chloromethyl)ether			N/A
2-Chlorophenol			10.0
4-Chloro-3-methyl phenol			10.0

METHODS AND QUANTIFICATION LIMITS FOR
ANALYSIS OF GROUNDWATER

Analyte	Technique	Analysis Method	Quantification Limit
<u>Semivolatile Organics (continued)</u>			
Dibutyl phthalate			10.0
Dichlorobenzenes			10.0
Dichlorobenzidine			20.0
2,4-Dichlorophenol			10.0
Diethylphthalate			10.0
2,4-Dimethyl phenol			10.0
Dimethyl phthalate			10.0
2,4-Dinitrotoluene			10.0
2,4-Dinitro-o-cresol			50.0
1,2-Diphenylhydrazine			N/A
Di-2-ethylhexylphthalate			10.0
Fluoranthene			10.0
Hexachlorobenzene			10.0
Hexachlorobutadiene			10.0
Hexachlorocyclopentadiene			10.0
Hexachloroethane			10.0
Isophorone			10.0
Naphthalene			10.0
Nitrobenzene			10.0
Nitrophenols			50.0
N-Nitrosodibutylamine			10.0
N-Nitrosodiethylamine			20.0
N-Nitrosodimethylamine			100.0
N-Nitrosodiphenylamine			10.0
N-Nitrosopyrrolidine			40.0
Pentachlorobenzene			10.0
Pentachlorophenol			50.0
Phenol			10.0
Phthalate esters			N/A
Polynuclear aromatic hydrocarbons			N/A
1,2,4,5-Tetrachlorobenzene			10.0
2,4,5-Trichlorophenol			50.0
2,4,6-Trichlorophenol			10.0
<u>Organochlorine Pesticides/PCBs</u>			
	GC/ECD	EPA 8081	(µg/L)
Aldrin			0.1
BHC			0.1
Chlordane			0.1
DDT			0.1
DDT metabolite (DDE)			0.1
DDT metabolite (DDD)			N/A
Dieldrin			0.02
Endosulfan			0.14
Endrin			0.1
Heptachlor			0.1

METHODS AND QUANTIFICATION LIMITS FOR
ANALYSIS OF GROUNDWATER

Analyte	Technique	Analysis Method	Quantification Limit
<u>Organochlorine Pesticides/PCBs (continued)</u>			
Hexachlorocyclohexane (lindane)			0.1
alpha-Hexachlorocyclohexane			0.1
beta-Hexachlorocyclohexane			0.1
Methoxychlor			0.5
PCBs			1.0
Mirex			10.0
Toxaphene			5.0
<u>Metals (total)</u>			
			(µg/L)
Antimony	ICP	EPA 6010	60
Arsenic	AA, furnace	EPA 7060	10
Beryllium	ICP	EPA 6010	5
Cadmium	ICP	EPA 6010	5
Chromium	ICP	EPA 6010	10
Copper	ICP	EPA 6010	25
Iron	ICP	EPA 6010	100
Lead	AA, furnace	EPA 7421	3
Manganese	ICP	EPA 6010	15
Mercury	Cold vapor	EPA 7470	0.2
Nickel	ICP	EPA 6010	40
Selenium	AA, furnace	EPA 7740	5
Silver	ICP	EPA 6010	10
Thallium	AA, furnace	EPA 7841	10
Zinc	ICP	EPA 6010	20
<u>Other Inorganics</u>			
Chloride	Ion chromatograph	EPA 300.0 ^(d)	0.2 mg/L
Nitrate	Ion chromatograph	EPA 300.0 ^(d)	0.2 mg N/L
Ammonia	Potentiometric	EPA 350.3 ^(d)	0.05 mg N/L
Total Kjeldahl nitrogen	Colorimetric	EPA 351 ^(d)	0.1 mg N/L
Total Phosphorus	Colorimetric	EPA 365.3 ^(d)	0.01 mg P/L
<u>Other Analyses</u>			
Turbidity		Field	±0.1 NTU
Specific Conductance		Field	±10 µmhos
pH		Field	±0.1 pH unit
Temperature		Field	±0.1°C
Alkalinity	Titrimetric	EPA 310.1 ^(d)	20 mg/L as CaCO ₃
Hardness	Calculation	EPA 6010	0.2 mg/L

METHODS AND QUANTIFICATION LIMITS FOR
ANALYSIS OF GROUNDWATER

Analyte	Technique	Analysis Method	Quantification Limit
<u>Field Parameters</u>			
pH	Potentiometric		0.1 pH unit
Specific Conductance	Conductance Cell		1 μ mho/cm
Temperature	Thermometric		0.2°C
Turbidity	Nephelometric		1 NTU

Bioassay Analyses

- (a) Methods from EPA 1986 unless otherwise noted.
- (b) Constituents of Concern.
- (c) N/A = not available.
- (d) Method from EPA 1983.

TABLE 8-11

AUDIT REPORT FORMAT

-
1. Purpose of Audit
 2. Audit Basis
 3. Time and Place of Audit
 4. Personnel Contacted
 5. Audit Team Members
 6. Summary of Events
 7. Findings and Recommendations
 - a. Positive Findings
 - b. Negative Findings
 8. Required Follow-up (responsible parties, summary of required corrective action, date of reaudit, if required)
 9. Distribution of Audit Report and Corrective Action Reports.

TABLE 8-11

AUDIT REPORT FORMAT

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Interim Draft

**Operation and Maintenance Manual
Appendix E
Field Sampling Plan**

August 10, 1994

Prepared for
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1026 West Broadway
Spokane, WA

Prepared by
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1.0 INTRODUCTION

This Field Sampling Plan (FSP) has been prepared in conjunction with the Quality Assurance Project Plan (QAPP) to address Remedial Action (RA) project sampling activities at the Colbert Landfill Superfund site. The purpose of the FSP is to provide detailed information on the procedures to be implemented when collecting groundwater and influent/effluent samples at the site. These field sampling procedures are intended to provide data that meet the data quality objectives (DQOs) set forth in the QAPP, and will be conducted in accordance with the quality assurance/quality control (QA/QC) requirements of the QAPP.

The FSP provides a general description of sampling frequency. However, the project RA is anticipated to require at least 30 years, and sampling frequency will vary depending on observed conditions during remedial action, based on the operational sampling frequency criteria specified in the project Consent Decree Scope of Work (SOW) (Section V).

The National Pollutant Discharge Elimination System (NPDES) monitoring requirements presented in this FSP are based on the interim discharge requirements identified in the Washington State Department of Ecology (Ecology) April 6, 1994 letter from Ali Raad (Ecology) to Dean Fowler (Spokane County). The interim discharge approval expires 90 days following initial discharge, and will be replaced (by Ecology) with final substantive NPDES requirements. This FSP and the QAPP will require modification if the final substantive requirements differ from the interim requirements.

As a contingency measure to the interim NPDES requirements lapsing prior to Ecology's issuance of the final substantive requirements, this FSP presents monitoring requirements that extend beyond the 90-day period, based on discussions between John Markus (Landau Associates) and Ali Raad on March 8, 1994, as described in Landau Associates' March 15, 1994 letter from John Markus to Dean Fowler. If it becomes necessary to implement these contingency monitoring requirements, approval must first be obtained from Ecology.

2.0 SAMPLING OBJECTIVES

The objective of the FSP is to assure that accurate, reproducible, and comparable data are acquired during the RA. To achieve this objective, this document details sample collection, handling, documentation, and security procedures. These procedures have been written to comply with the *Compendium of Superfund Field Operations* (EPA/540/P-87/001, OSWER 9355.014, September 1987). Standards have been developed for evaluation of the field sampling procedures with respect to the project objectives.

Any changes in sampling procedures as outlined in this document will be described on the Modification to Field Sampling Plan form (Form E-1). Approval from the Field Services Project Manager will be needed prior to implementation of any changes.

3.0 SAMPLING LOCATION, ANALYSIS, AND FREQUENCY

Groundwater and treatment system influent/effluent samples will be collected and analyzed for selected parameters during Phase II of the project. Phase II sampling and analysis consists of:

- Groundwater: to be collected from 24 compliance monitoring wells and 10 extraction wells to provide data to evaluate interception system performance and RA progress. Groundwater samples may also be collected from additional monitoring wells and private wells to evaluate RA progress, at the discretion of Spokane County.
- Influent/Effluent: to be collected from the intake and discharge sides of the treatment system (air stripping tower) to 1) provide data on the effectiveness of the treatment system in reducing concentrations of the Constituents of Concern to levels specified in the Consent Decree, 2) (in the case of effluent) provide data on selected water quality parameters to assess system compliance with National Pollution Discharge Elimination System (NPDES) requirements governing industrial discharges to surface receiving waters, and 3) determine treatment system air emissions (by groundwater influent/effluent mass balance).
- Receiving Water: to be collected from one location upstream and one location downstream of the treatment facility outfall in the Little Spokane River to provide data on the impact of effluent discharge on algal growth potential for the Little Spokane River.

Groundwater monitoring well and extraction well locations comprising the RA compliance sampling network, the treatment facility, receiving water sampling locations, and the treatment facility outfall are shown on Figure E-1. Constituents/parameters to be analyzed (for each sampling type and matrix) and the frequency of sampling are presented in Table E-1. Analytical methods are described in Table E-2. In addition to parameters and constituents indicated in Table E-1, influent/effluent and groundwater samples will be field monitored for pH, specific conductivity, turbidity, and temperature by either mechanical or electronic means.

The number of wells at each Phase II monitoring location is provided in Table E-2 (only one well is present at each extraction well location).

4.0 SAMPLE COLLECTION AND ANALYSIS PROCEDURES

This section presents descriptions of the equipment and step-by-step procedures to be used for collecting, handling, and analyzing RA groundwater (Sections 4.1 and 4.2), treatment system influent and effluent (Section 4.3), and receiving water samples (Section 4.4). A summary of sample containers, preservation requirements, and holding times is presented in Table E-4.

4.1 GENERAL SAMPLING PROCEDURES

This section describes procedures applicable to all sampling performed at the site, including sampling of groundwater monitoring/extraction wells, treatment system influent/effluent, and receiving waters. These procedures are for sample containers; sample labels; field measurements of pH, conductivity, temperature, and turbidity; sample bottle filling; chain-of-custody; chain-of-custody seals; field records; and shipment of samples.

CAUTION: Groundwater extraction well vaults are confined spaces. Well vaults and monitoring wells may accumulate methane gas or toxic vapors in concentrations that are flammable or toxic. Refer to the safety section of the O&M manual (Section 8.0) for confined space entry procedures, air monitoring procedures, and other health and safety procedures.

4.1.1 Sample Containers

All sample containers will be QC certified according to EPA specifications and will be obtained through the analytical laboratory. The laboratory will add the proper preservatives to the appropriate containers prior to sample collection.

4.1.2 Sample Labels

Sample labels are necessary to properly identify samples. Gummed paper labels or tags are adequate for RA activities and will include the following information:

- Sample identification number
- Date and time
- Name of sampler
- Pertinent field information
- Analysis requested.

Labels will be completed and affixed to sample containers prior to or at the time of sampling.

4.1.3 Field Measurements

Conductivity, pH meters, turbidity, and temperature measuring devices will be calibrated following the instrument manufacturer's procedures (Section 5.0). These meters will be calibrated prior to sampling, and at least once for every 4 hours of sampling. Calibration adjustments will be recorded in a log book maintained for each meter. After each sample is collected, the calibration will be checked by measuring a standard solution and recording the reading and the solution temperature on the Sample Collection Form.

Four replicate field measurements of temperature, pH, conductivity, and turbidity will be made using the following procedure:

- Rinse a 250-mL plastic beaker three times with sample water.
- Rinse the electrode, dip cell, temperature compensation probe, and turbidity sensor by storing them in sample water for at least one minute.
- Set the automatic temperature compensator on the pH meter to the "on" position.

- Discard the water in the beaker; fill the beaker with new sample water; place the probes in the beaker for 1-2 minutes or until the reading stabilizes. Read the temperature, pH, conductivity, and turbidity measurements and record on the Sample Collection Form.
- Measure and record three additional sample replicates by repeating this last step; rinse beaker with sample water to be measured between each measurement.
- Note any problems or significant observations in the "comments" section of the Sample Collection Form (Form E-2).

4.1.4 Filling Sample Bottles

Sample bottles will be filled directly from the bailer or pump, or other sampling device. When sampling for volatile organics, bottles will be filled with a minimal amount of air contact. A slow, steady transfer rate will be used during sample collection.

The following procedures and precautions will be adhered to when filling sample bottles:

- Bottle caps will be removed carefully so that the inside of the cap is not touched. Caps will not be placed on the ground. Caps for volatile organics analyses contain a teflon-lined septum. The teflon side of the septum must be facing the sample to prevent contamination of the sample through the septum.
- The sample bottles will be filled with a minimal amount of air contact and without allowing the sampling equipment or personnel to contact the inside of the bottles. Tubing or hoses from pumps or sampling nozzles will not be placed into the sample bottles.
- Sample bottles containing preservatives should be filled completely, but not over filled. Bottle caps should be replaced tightly.
- Vials for volatile organics analyses will be filled so that they are headspace-free (i.e., no air bubbles in the sample bottle). The caps will be replaced gently, so as to eliminate any air bubbles in the sample. These bottles will then be checked for air bubbles by inverting them and shaking the bottle. If any air bubbles appear, the bottles will be reopened, topped off, and recapped. If an air bubble is present after topping off, the bottle will be discarded and a new bottle will be filled.
- Each set of two or three volatile organics analyses sample bottles will be placed in a plastic bag. Samples should be placed into an ice chest immediately after collection to prevent loss of volatile organics through exposure to sunlight and warm temperatures.

4.1.5 Chain of Custody

To establish the documentation necessary to trace sample possession from the time of collection, a Chain-of-Custody Record similar to that shown on Form E-3 will be filled out and will accompany every sample delivery to the laboratory. The record will contain the following information:

- Sample identification number
- Name of person taking sample
- Date and time of collection
- Signatures of persons involved in the chain of possession (the sampler will be the first person to relinquish custody)
- Inclusive dates of possession.

The Chain-of-Custody Record will be completed by field personnel in duplicate for all sampling. When samples are transferred, the person relinquishing the samples will sign the Chain-of-Custody Record and record the date and time of transfer. The sample collector will sign the form in the first signature space. A designated sample custodian will accept custody of the shipped samples and certify that the sample identification number matches that on the Chain-of-Custody record. The custodian will then enter sample identification number data into the logbook. Copies of the completed Chain-of-Custody Records will be retained by the analytical laboratory, in the project files, and by the QA Coordinator (QAC). The laboratory will include a copy of the Chain-of-Custody Record in its report of analytical results. Project documentation of sample custody will be verified during regular review of the data validation package.

4.1.6 Chain-of-Custody Seal

A Chain-of-Custody Seal similar to that shown on Form E-4 (used to detect unauthorized tampering with the samples) will be placed on the ice chest after collection of all samples and whenever samples are left unattended. The seal will include, at a minimum, the sampler's name and the date. The seal will be attached such that it must be broken in order to open the ice chest. The seal will be affixed to the ice chest before the sampling personnel relinquish custody

of the samples. The seal will be broken only by the designated sample custodian upon receipt of the ice chest at the laboratory.

4.1.7 Field Records

Field log books, plus the Sample Collection Forms, will be used to record all information pertinent to the sampling event. The records will contain sufficient information to permit reconstruction of sampling events without reliance on the sampler's memory. All field log books and forms will be retained by the Field Coordinator and secured in a safe place.

4.1.8 Shipment of Samples

A Sample Analysis Request Packing List (Form E-5) will accompany the samples to the laboratory. This form will be completed by field personnel and will specify the analysis to be performed by the analytical laboratory. Samples will be shipped to the laboratory within 24 hours of sampling, except that samples collected on a Friday will typically be stored in a refrigerator over the weekend and shipped to the laboratory on Monday. Special arrangements will be made with the laboratory for timely receipt of samples collected with short holding times that are collected on a Friday.

The samples will be accompanied by a Chain-of-Custody Record and will be delivered to the laboratory representative authorized to receive samples. The laboratory representative will sign the Chain-of-Custody Record to verify delivery/receipt.

4.1.9 Sample Handling

Sample container description, preservation method, and maximum holding time for planned analyses are presented for each sample type in Table E-4. Sample handling procedures will depend upon the required method of preservation. Each sample that is preserved with acid will be placed in a separate plastic bag. As much air as possible will be squeezed from the bags before sealing. Samples preserved with acid will either be transported directly to the laboratory by automobile or will be shipped on an overnight carrier. Samples that are not preserved with acid do not need to be placed in separate bags prior to shipment to the laboratory.

For all samples, an ice chest will be used as a shipping container. In preparation for shipping samples, the drain plug will be taped shut from the inside and outside. Approximately 1 inch of packing material, such as asbestos-free vermiculite, will be placed in the bottom of the ice chest. The sample bottles will be placed in the ice chest. All ice chests will contain ice or frozen gel packs. The ice chest will be filled with sufficient packing material to prevent sample containers from making contact during shipment. The paperwork accompanying the samples to the laboratory will be put into the cooler inside a plastic bag and put into the cooler above the vermiculite packing. The ice chest will be taped shut with strapping tape. At least two Chain-of-Custody Seals (Form E-4) will be placed on the outside of the ice chest (one on the front and one on the back).

4.2 GROUNDWATER MONITORING/EXTRACTION WELL SAMPLING

Groundwater monitoring well and extraction well sampling will be conducted in accordance with the procedures described in the following subsections. Dedicated sampling equipment is installed in all RA compliance monitoring wells and extraction wells; however, some monitoring wells that are not part of the RA groundwater compliance monitoring system and that do not have dedicated sampling equipment may also be sampled periodically. Therefore, this section presents sampling procedures for both dedicated and nondedicated sampling equipment.

4.2.1 Water Level Measurements

For monitoring wells, water levels will be measured with an electronic water level indicator just prior to purging and sampling. For extraction wells, water levels will be measured using the dedicated well water level instruments, and confirmed at least quarterly using a nondedicated electronic water level indicator. Measurements will be made from the surveyed point on the top of the well casing. If a nondedicated water level probe is used, it will be decontaminated before and after each measurement with a distilled water rinse. Depth to water will be recorded to the nearest 0.01 ft on the Sample Collection Form (Form E-2).

4.2.2 Purging the Well

Prior to sampling, monitoring wells will be purged by removing at least three well volumes of water from the casing using an air-driven, piston, or bladder pump fitted with teflon-lined polyethylene or stainless-steel tubing. If the pump is nondedicated, the interior of the tubing and the pump will be washed with an Alconox and water solution, rinsed with tap water, and then rinsed with distilled or deionized water following use. The exterior of the tubing will be decontaminated with a high-pressure, hot water pressure washer. During decontamination, rinse water will not be allowed to drip onto the plastic sheeting under the decontaminated pump and tubing.

The well purge volumes for normally sampled groundwater monitoring wells are listed in Table E-5. For other wells, the well purge volume will be calculated based on the following formula: one well volume (gallon) = $\pi r^2 h \times 7.48 \text{ gal/ft}^3$; where $\pi = 3.14$, r = radius of well casing in feet, and h = height of water column from the bottom of the well in feet. Information on purge volume, date and time of initiation and termination of pumping, plus a description of the physical characteristics of purged water (color, turbidity, etc.) based on visual observation, will be recorded on the Sample Collection Form (Form E-2). In most instances, sampling will be completed the same day as well purging. However, if the well becomes dry during purging, it will be sampled as soon as the water level has recovered enough to allow collection of the necessary samples, which may require sampling on a subsequent day. The start and end date and time of purging, as well as the date and time of sample collection, will be recorded on the Sample Collection Form.

Extraction wells will normally be operating and thus will not require purging. However, if an extraction well is not operating at the time of sampling, it will be briefly operated (if possible) to purge the required three well volumes prior to sampling.

Purged water will be disposed of as follows:

- From monitoring wells with a history of contamination below the levels of regulatory concern: water will be discharged to the ground, if appropriate given well location (water will not be discharged to private residence lawns or other "sensitive" areas)

- From extraction wells and from monitoring wells with contamination above or suspected to be above levels of regulatory concern: water will be collected in a tank or other container, transported to the treatment facility, and discharged to one of the treatment facility sumps (sump water is automatically pumped to the air stripping tower).

4.2.3 Groundwater Sampling

Groundwater samples from the monitoring wells will be collected with the aid of a bladder pump, piston pump, or a stainless-steel or teflon bailer. If the pump or bailer is nondedicated, it will be decontaminated by washing with an Alconox and water solution, then rinsing with tap water, and finally, rinsing with distilled or deionized water following use. During decontamination, rinse water will not be allowed to drip onto the plastic sheeting under the decontaminated pump and tubing. The pump (or bailer) will also be rinsed with distilled or deionized water prior to use at a new location.

The following precautions will be followed when using a nondedicated pump or bailer to collect groundwater samples:

- Between decontamination and placement in the well, the pump or bailer will not contact any surface except the inside of a clean carrying case
- The pump or bailer will be lowered slowly into the well
- The pump or bailer will not be allowed to come into contact with any surface other than the inside of the well casing.

Extraction wells will be sampled from the piping drain valve in the well vault immediately downstream from the wellhead. Sampling procedures are identical to the influent/effluent sampling procedures described in Section 4.3. The required sample line purge volume prior to sampling is approximately 1/2 gallon (2 L).

4.2.4 Monitoring/Extraction Well Sample Quality Control (QC)—Volatile Organics Analyses

Approximately 25 percent of the total number of monitoring/extraction well samples will be collected as QC samples. The four types of field QC samples that will be collected for volatile organic Constituents of Concern analyses are: 1) rinsate blank, 2) field duplicate, 3) transfer blank, and 4) trip blank. Whenever possible, every tenth sample will be either a duplicate or a

transfer blank. Trip blanks will accompany each ice chest containing groundwater samples for volatile organic analyses. The types of field QC samples are described below:

- **Rinsate Blanks:** For wells that are not equipped with dedicated sampling equipment, a minimum of 5 percent of the total number of non-QC groundwater samples (collected from monitoring and extraction wells without dedicated sampling equipment) for VOA will be collected as rinsate blanks to check equipment decontamination procedures. Rinsate blanks will be collected following sampling from wells that are expected to contain relatively high concentrations of volatile organics. Equipment rinsate blanks will be prepared without making any special effort when decontaminating the sampling equipment. The rinsate blank will consist of deionized/distilled water poured over the cleaned sampling equipment and collected into septum vials (appropriately sized containers) for laboratory analysis.
- **Field Duplicate Samples:** A minimum of 5 percent of the total number of water samples will be collected and analyzed as field duplicates. At a minimum, one duplicate will be collected from each of the South and West Interception and East Extraction Systems during RA sampling. Duplicate samples will be collected by alternately discharging the pump or bailer into duplicate sample bottles. Each duplicate sample will have a separate sample number and Sample Collection Form so that laboratory personnel will not know the sample is a duplicate.
- **Transfer Blanks:** A minimum of 5 percent of the total number of water samples will be sent to the laboratory as transfer blanks. A transfer blank will be collected by transferring deionized (DI)/distilled water, provided by the analytical laboratory, into a set of sample bottles. Each transfer blank will be identified and logged on a separate Sample Collection Form. Upon return to the laboratory, the transfer blank will be analyzed as if it were a field sample, following the same QA/QC procedures as ordinary samples.
- **Trip Blanks:** One trip blank will be included in each ice chest containing groundwater samples. A trip blank will consist of a sample bottle filled by the analytical laboratory with deionized/distilled water. The blank will remain with the sample bottles in transit to and around the site during sampling and the return trip to the laboratory. At no time during these sampling activities is the trip blank to be opened. Upon return to the laboratory, the trip blank will be analyzed as if it were another field sample receiving the same QA/QC procedures as ordinary samples. If no volatile organic constituents are detected in any sample in a ice chest, the accompanying trip blank need not be analyzed.

4.3 TREATMENT SYSTEM INFLUENT/EFFLUENT SAMPLING

Samples of treatment system influent/effluent will be collected and analyzed during Phase II project activities to evaluate the efficiency of the treatment system in removing the Constituents of Concern and to evaluate system compliance with NPDES requirements. Treatment System influent/effluent sampling will be performed in accordance with the procedures described in the following subsections.

4.3.1 Sample Collection Procedures

Samples of treatment system influent/effluent will be collected from sample taps on the influent and effluent piping. There are five influent sample taps, one on each of the three well system influent headers, one on the combined influent pipeline, and one on the treatment system bypass pipeline. The influent sample taps are located in the treatment facility process area at the sample sink. One effluent sample tap is located on the discharge line from the air stripping tower, approximately 4 ft upstream of the discharge line shutoff valve HV 24-3. Each sample tap line terminates with a needle valve that regulates the flow of the water to be sampled.

Sampling will be accomplished as either grab or composite samples, as indicated in Table E-1. Grab samples will be collected using the following procedure:

- Open sample line isolation valve at connection to pipeline (influent sample lines only)
- Open needle valve and purge sample line (see Table E-6 for sample line purge volumes)
- Close needle valve partially to adjust flow to gentle stream
- Fill bottles using procedures set forth in Section 4.1.4
- Close needle valve and sample line isolation valve.

Composite samples will be collected using the following procedure:

- Install two valve flow splitter on sample line (to allow simultaneous collection of sample and bypass of sample line purge water). Use teflon tape, not plumber's putty, if necessary to seal threaded connections. Provide needle valve for sample tap and ball valve for purge water. Valves must have hose barb-type outlets.
- Open sample line isolation valve at connection to pipeline (influent sample lines only).

- Open purge valve and purge sample line (see Table E-6 for sample line purge volumes).
- Close purge valve partially to achieve desired purge flow rate (see Table E-6 for purge flow rates).
- Prepare composite sampling container [low-density polyethylene (LDPE) bag], which must have a cap with hose barb and approximately 3 ft of tygon or teflon tubing.
- Open needle valve and adjust flow rate to evenly fill container over desired sampling period. Verify flow rate using graduated cylinder. Calculate desired flow rate by:

$$Q = 63 \times V / t \quad \text{where:} \quad \begin{array}{l} Q = \text{Sample flow rate (mL/min)} \\ V = \text{Sample container volume (gallons)} \\ t = \text{Composite duration (hours)} \end{array}$$

$$\text{or} \quad Q = 16.67 V / t \quad \text{where:} \quad \begin{array}{l} Q = \text{Sample flow rate (mL/min)} \\ V = \text{Sample container volume (liters)} \\ t = \text{Composite duration (hours)} \end{array}$$

For example, for a 5-gallon container and a 24-hour composite duration, the required flow rate is:

$$Q = 63 \times 5 / 24 = 13 \text{ mL per minute}$$

NOTE: Significant changes in pipeline pressure may alter sample flow rate. Therefore, pipeline pressure must be monitored during the sampling period. Influent pipeline pressure can be read directly from the line pressure gauge or at the treatment facility main control panel. Effluent pipeline pressure is equivalent to depth of water in the air stripping tower clearwell.

- Temporarily connect the LDPE bag to purge valve. Fill bag approximately 10 percent full of water. Disconnect bag from purge valve and squeeze to remove all air bubbles from bag. After air is removed, hold bag upside down to drain. Suction created by draining bag through tubing will collapse bag as it empties and prevent entry of air into bag. When bag is mostly collapsed and drainage flow slows, pinch tubing end closed.
- Connect tubing to needle valve; prevent entry of air into tubing. If more than a few small air bubbles are present, repeat the previous step and this step until satisfactory results are obtained. Note sample start time in sample collection log book.
- Place bag in cooler with ice.
- Monitor filling of bag periodically during compositing period. Monitor pipeline pressures. Add ice as necessary.

- At the end of the compositing period, pinch the end of the sample tubing closed and disconnect tubing from the needle valve. Take care to prevent air from entering tubing or bag. Manipulate bag to mix contents.
- Invert bag and unpinch hose so that bag drains. Fill sample bottles using procedures set forth in Section 4.1.4.
- Close needle valve, purge valve, and sample line isolation valve.

4.3.2 Treatment System Quality Control (QC) Samples

Approximately 20 percent of the total number of treatment system influent/effluent samples will be collected as QC samples. Whenever possible, every tenth sample will be either a duplicate or blank, and will be collected in the following order: 1) duplicate, 2) transfer blank, and 3) trip blank. Rinstate blanks will not be collected because samples will be collected from dedicated equipment (i.e., sample ports permanently installed on the stripping tower). The types of field QC samples are described below:

- **Field Duplicate Samples:** A minimum of 5 percent of the total number of influent/effluent samples will be collected and analyzed as field duplicate samples. Field duplicate samples will be collected by alternately filling duplicate sample bottles. Each duplicate sample will have a separate sample number and Sample Collection Form so that laboratory personnel do not know the sample is a duplicate.
- **Transfer Blanks:** A minimum of one transfer blank will be collected every twentieth sample by transferring DI/distilled water, provided by the analytical laboratory, into a set of sample bottles. Each transfer blank will be identified and logged on a separate Sample Collection Form. Upon return to the laboratory, the transfer blank will be analyzed as if it were a field sample, following the same QA/QC procedures as ordinary samples.
- **Trip Blanks:** A trip blank will accompany each ice chest containing stripping tower samples to be analyzed for volatile organic compounds. A trip blank will consist of a sample bottle filled with DI/distilled water by the laboratory. The blank will remain with the sample bottles in transit to and around the site during sampling and the return trip to the laboratory. At no time during these sampling activities is the trip blank to be opened. Upon return to the laboratory, trip blanks will be analyzed for at least one out of every five sampling events (about 10 percent of the total number of influent/effluent samples). Additionally, the trip blank will be analyzed if anomalously high concentrations or low detections are reported by the laboratory for the associated effluent sample. The trip blank will be analyzed as if it were another field sample, following the same QA/QC procedures as ordinary samples.

4.4 RECEIVING WATER SAMPLING

Receiving water sampling for algal growth potential will be conducted at two locations in the Little Spokane River, as shown on Figure E-1. One location is upstream of the outfall, and one location is approximately 300 ft downstream of the outfall, at the edge of the mixing zone. All receiving water samples will be collected as grab samples. The sample collection procedure is as follows:

- Collect sample from shore or wading zone using a 15-ft telescoping aluminum pole. Affix sample bottle to end of pole using rope or twine (do not use tape), a bottle clamp, or a basket.

Note: When sampling for volatile organic compounds or for other parameters that require a preservation agent (e.g., acid), collect sample in 1-L glass bottle (or other container as appropriate), and transfer sample to final container immediately following collection.

- When sampling into final container, decontaminate outside of sample bottle before sampling by washing with an Alconox and water solution, then rinsing with tap water, and finally, rinsing with distilled or deionized water. When not sampling directly into final container, decontaminate inside and outside of intermediate container before sampling and between each sample location, as described above.
- Remove cover from sample bottle.
- Using pole, extend bottle over river, to a point slightly upstream from sampler. With bottle opening facing upstream, lower bottle gently into water, and push down until bottle is approximately 1 foot below water surface. Fill bottle slowly and continuously. Keep pole pointing slightly upstream. Gently raise bottle from water, keeping bottle as full as possible. Swing bottle to shore.
- Fill sample bottle from intermediate container using procedures set forth in Section 4.1.4 (if applicable).
- Cap sample bottle and place in ice chest.

5.0 FIELD INSTRUMENT CALIBRATION PROCEDURES

5.1 pH METER

The pH of water samples will be measured using the instrument manufacturer's instructions for calibration and use. A two-buffer calibration with Automatic Temperature Compensation (ATC) will be used at a minimum of every four hours during sampling. The manufacturer's instructions follow.

MEASUREMENT PROCEDURES

pH Measurements

For maximum accuracy:

Perform a two buffer calibration once at the beginning of each day. This procedure provides the correct setting for the °C/slope control. Subsequent measurements can be made after a single buffer calibration.

Use ATC probe to automatically compensate for changes in slope due to variations in sample temperature.

Two Buffer Calibration (With ATC)

1. Plug ATC probe into input jacks and adjust °C/slope control knob to 25°C. Slide mode switch to temperature. Verify that ambient temperature is displayed.
2. Place electrodes in pH 7 buffer and stir moderately.
3. Slide mode switch to pH. Allow reading to stabilize, then adjust calib control so that correct buffer value at that temperature is displayed.
4. Remove electrodes from the buffer solution, rinse, and place electrodes in second buffer. Stir moderately. Allow reading to stabilize.
5. Adjust °C/slope control until correct value of second buffer is displayed. Remove electrodes from solution, rinse and place electrodes in sample. Stir moderately. Allow reading to stabilize.
6. Record pH value displayed.

Two Buffer Calibration (Without ATC)

1. Sample and buffer temperature must be equal. Set °C/slope control to buffer temperature (°C).
2. Place electrode in pH 7 buffer and stir moderately.
3. Slide mode switch to pH. Allow reading to stabilize, then adjust calib control so that correct buffer value at that temperature is displayed.
4. Remove electrode from the buffer solution, rinse, and place electrode in second buffer. Stir moderately. Allow reading to stabilize.
5. Adjust °C/slope control until correct value of second buffer is displayed. Remove electrode from solution, rinse and place electrode in sample. Stir moderately. Allow reading to stabilize.
6. Record pH value displayed.

If sample temperature differs significantly from the buffer temperatures used to calibrate, an adjustment can be made. Raise or lower the °C/slope control from its current setting, described in step 5, by the difference between the actual buffer temperature and the sample temperature. For maximum accuracy use ATC probe.

Single Buffer Calibration (With ATC)

The ATC probe replaces the manual temp/slope control on front panel with automatic compensation based on sensed sample temperature.

1. Plug ATC probe into input jacks and adjust °C/slope control knob to 25°C. Slide mode switch to temperature. Verify that ambient temperature is displayed.
2. If incorrect, adjust °C/slope control knob until actual temperature is displayed.
3. Place electrodes in a buffer solution with pH value within 1.5 units of the expected sample value and stir moderately.
4. Slide mode switch to pH. Allow reading to stabilize, then adjust calib control so that pH value of buffer is displayed.
5. Remove electrodes from the buffer solution, rinse, and place electrodes into sample. Stir moderately. Allow reading to stabilize.
6. Record pH value displayed.

Single Buffer Calibration (Without ATC)

1. Sample and buffer temperature must be equal. Set °C/slope control to buffer temperature (°C).
2. Place electrode in a buffer solution with pH value within 1.5 units of the expected sample value and stir moderately.
3. Slide mode switch to pH. Allow reading to stabilize, then adjust calib control so that correct buffer value at that temperature is displayed.
4. Remove electrodes from the buffer solution, rinse, and place electrodes into sample. Stir moderately. Allow reading to stabilize.
5. Record pH value displayed.

5.2 CONDUCTIVITY METER

The conductivity of the water samples will be measured using the instrument manufacturer's instructions, which follow.

DRAFT

CONDUCTIVITY STANDARDS

Approximate Normality	Weight of KCl in grams/1000 grams of Solution	Conductions in Micromhos @ 25°C
1.	71.1352	111,342
.1	7.41913	12,856.0
.01	.745263	1,408.77

MAKING CONDUCTIVITY & TDS MEASUREMENTS
with The Model 604

I Cell Constant determination

Power "ON" (Lo Batt not on)
Cell connected
Function to A. T. C. "ON"
Range to "2000" $\mu\Omega$

Using three samples of the 718 $\mu\Omega$ standard solution (shipped with the Model 604), held at 25°C, dip the cell in the first solution. Allow the cell to temperature equilibrate to the standard solution. Withdraw cell and dispose of excess solution. Do not touch or wipe off the cell. Repeat this process in the second solution. Place the cell in the third solution for measurement. Measurement is to be made once cell is in the third solution. This reading will be most accurate if the measurement is made as soon as the cell is dipped in the third solution. Readings may change in some cases due to gases or other impurities absorbed from the atmosphere. Using the calibration tool set the standardize control to display .718. By changing the Function Switch to the standardize position, the constant maybe read directly from the display. (Example: 9.96; 10.00; 10.04). The Instrument is now ready to make percise conductivity measurements. In making measurements of unknown solutions, select '200,000' on Range Switch, ATC "ON" with Function Switch. Using three samples of the 'unknown solution', rinse the cell in the first sample solution.

Allow the cell to temperature equilibrate in the solution. Withdraw cell and dispose of excess solution. Do not touch or wipe off cell. Repeat this process in the second sample solution. Place the cell in the third solution for measurement. Measurement is to be made as soon as cell is in the solution. Having selected the appropriate range for reading, record same.

CALIBRATION & MAINTENANCE

Preventative Maintenance

1. The Model 604 requires no periodic maintenance.
2. Cleaning of the Model 604 should be done with a mild soap solution and a damp cloth.

CAUTION

DO NOT ALLOW FLUIDS TO RUN INTO THE INSTRUMENT.

ZERO CALIBRATION

Checking for proper Zero of Instrument.

Select ATC "ON"

Power "ON"

Cell connected (Dry & Clean)

Select these two ranges - 2 & 200,000 micromhos. In both positions the Digital Display should read 0 plus or minus a count. If not a Zero Calibration should be performed. Remove four attaching screws on back of cover. Remove back cover. Consult the Component Layout Diagram (Reverse Side) in this publication for the location of R49 & R69. Diagram is found on page 12. R49 & R69 maybe accessed from reverse side of board. Holes are provided in PC Board for this purpose.

Instrument Power "ON"

Function Switch ATC "ON"

Range Switch "200,000"

Cell connected (Dry & Clean)

Adjust R49 for zero reading. Position Range Switch to "2". Adjust R69 for a Zero reading. This completes Zero Calibration. Reassemble the Instrument.

USER INFORMATION

1. Care must be taken to avoid solution 'carry over'. The cell should be rinsed in a sample of the solution to be measured before the actual measurement is made.
2. Equilibrating the Cell - Agitate the cell in the solution to expediate temperature equilibration, and also assists in the dislodging of air bubbles.
3. Immersion of Cell - Cell is to be immersed in the solution a minimum of 1½ inches for proper measurement.
4. Thermistor Time Constant - The Cell's Thermistor time constant is approximately eighteen seconds.
5. Sample Measurements - Minimum amount of solution required for measurement - 1 ml in 10 mm test tube (10).

5.3 THERMOMETER

Model: Taylor Pocket Thermometer #21430-1

(Range = 30° to 50° C)

1. Thermometer Calibration Procedure

- a. Each thermometer is labeled with an identifying number. The thermometer calibration will be documented in a dedicated calibration log book. All instrument calibrations and repairs will be recorded in the calibration log. The log book will describe the thermometer (make, model, purchase date, serial number, probe type, etc.).
- b. All thermometers will be calibrated against an NBS-traceable thermometer, which will not be used in the field but will be retained at the treatment facility as a calibrated standard.
- c. Thermometers will be calibrated immediately after purchase and every six months thereafter, or if any unusual readings are obtained.

2. Temperature Measurement Procedure

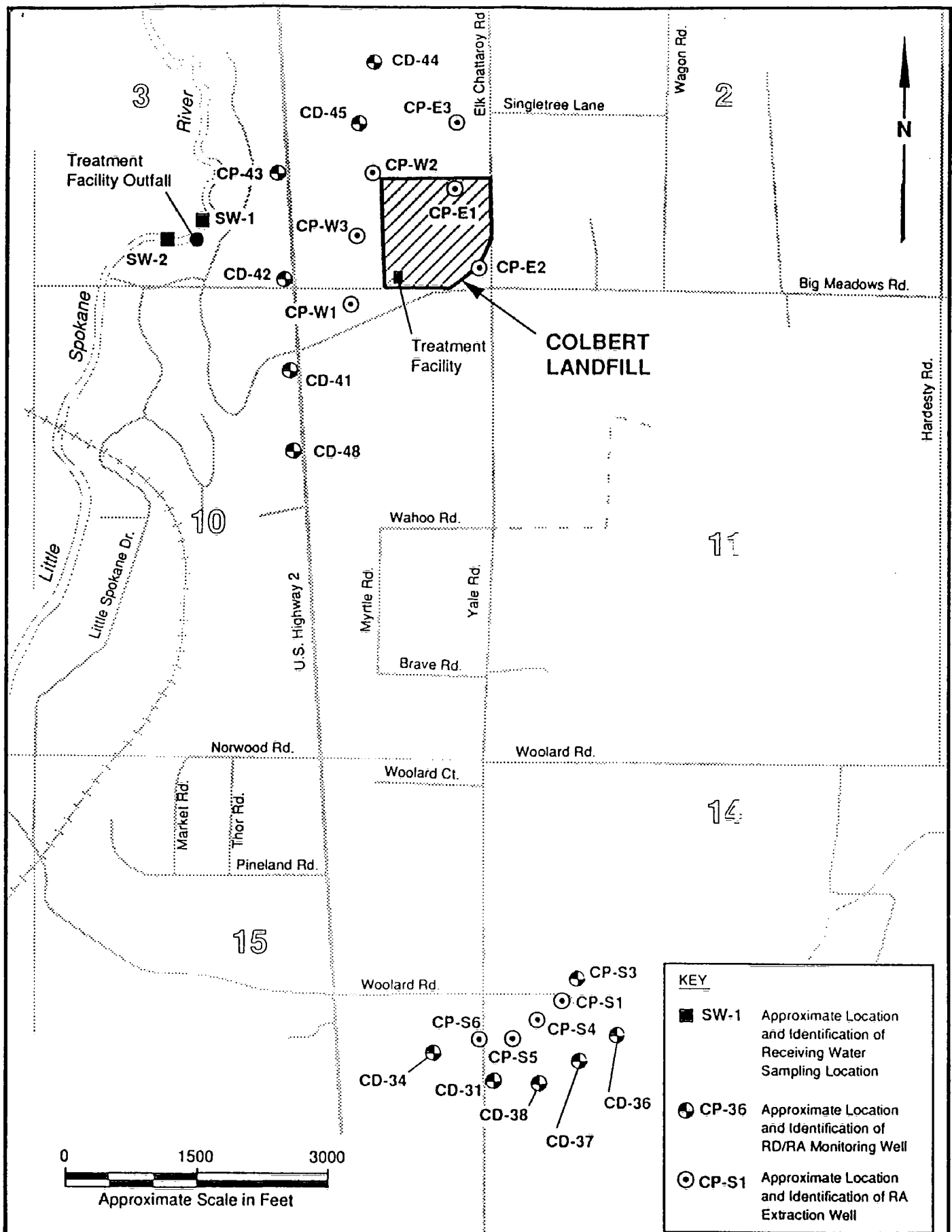
- a. Immediately prior to calibration, the operator will enter his or her name, the date, and the time of calibration in the log book. The instrument will be calibrated indoors.
- b. A two-point calibration will be conducted as follows: first, both the thermometer being calibrated (i.e., the field thermometer) and the NBS-traceable thermometer will be immersed in a container of ice and water. After waiting for the reading to stabilize, the operator will record both readings and calculate the error on the field thermometer. The procedure will be repeated with the water at room temperature (approximately 20-25°C). The field thermometer will be considered to be calibrated if it reads within 1°C of the NBS-traceable thermometer (i.e., $\pm 1^\circ\text{C}$). The information will be recorded as follows:

Initials	Date (ddmmyy)	Time	Temp NBS	Temp Field	Error (Field-NBS)
JML	3/3/88	1324	0.5	1	+0.5
JML	3/3/88	1324	18	19	+1.0

5.4 TURBIDIMETER

Turbidity of water samples will be measured using the instrument manufacturer's instructions, which follow.

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Extraction and Compliance Monitoring Well Location Map

Figure E-1

Modification To Field Sampling Plan

Sample Program Identification: _____

Material to be Sampled: _____

Measurement Parameter: _____

Standard Procedure for Analysis: _____

Reference: _____

Variation from Standard Procedure: _____

Reasons for Variation: _____

Special Equipment, Material or Personnel Required: _____

Author's Name: _____

Approval: _____ Title: _____ Date: _____

Reviewed by: _____

Comments: _____

Reviewed by: _____

Comments: _____

PURGE DATA

Well Condition: Secure (☐ Yes / ☐ No); Describe Damage_____

(remove 3 well volumes or until pH/conductivity stabilize)

Volume of Schedule 40 PVC Pipe				
Diameter	O.D.	I.D.	Volume Gal/Linear Ft.	Weight of Water Lbs/Linear Ft.
1 1/4"	1.660"	1.380"	0.08	0.64
2"	2.375"	2.067"	0.17	1.45
3"	3.500"	3.068"	0.38	3.20
4"	4.500"	4.026"	0.66	5.51
6"	6.625"	6.065"	1.5	12.5

Turbidity

Purge Water Disposal to _____

SAMPLING DATA

Sample Description (Color, Texture, Density, Moisture, Turbidity, Etc.) _____

FIELD PARAMETERS

Turbidity (NTU)

4

ADDITIONAL INFORMATION

Quantity, Types of Sample Containers _____

Comments: (Why Analyze, Calculations, Etc.) _____

3/80

CUSTODY SEAL

LANDAU ASSOCIATES, INC.
P.O. BOX 1029 / EDMONDS, WA 98020-9129
PHONE: (206)778-0907 / FAX: (206)778-6409

Signature _____ Date _____

Sample Analysis Request Packing List

SAMPLER: _____	Sampling Date(s): _____	Ship To: Attn: _____	For Lab Use Only
Sampling Contact: _____	Date Shipped: _____		Date Samples Rec'd _____
(name) _____	Site Name/Code: _____		Rec'd By: _____
(phone number) _____	_____		_____

Sample Numbers	Sample Description I.e., Requested Analysis, Matrix, Concentration	Sample Condition on Receipt at Lab
1. _____	_____	_____
2. _____	_____	_____
3. _____	_____	_____
4. _____	_____	_____
5. _____	_____	_____
6. _____	_____	_____
7. _____	_____	_____
8. _____	_____	_____
9. _____	_____	_____
10. _____	_____	_____
11. _____	_____	_____
12. _____	_____	_____
13. _____	_____	_____
14. _____	_____	_____
15. _____	_____	_____
16. _____	_____	_____
17. _____	_____	_____
18. _____	_____	_____
19. _____	_____	_____
20. _____	_____	_____

For Lab Use Only

Form E-5

TABLE E-1
PHASE II SAMPLING AND ANALYSIS PROGRAM
COLBERT LANDFILL REMEDIAL DESIGN/REMEDIAL ACTION^(a)

Project Activity	Sample Type and Location	Total No. of Samples	Purpose of Sampling	Matrix	Analysis	Frequency
Downgradient Groundwater Compliance Monitoring Well Sampling	Grab: Monitoring Well Samples South System (CD-31, CD-36, CD-37, CD-38) West System (CD-41, CD-42, CD-43, CD-44, CD-45, CD-48) East System (none)	4 18 0 22 per sampling event; or about 3,000 samples for the 30- year life of the project	- Performance monitoring of South and West Interception Systems - Evaluating progress of remedial action	Groundwater	- Indicator compounds (1,1,1-TCA; 1,1-DCE; 1,1-DCA; TCE) - Constituents of Concern (1,1,1-TCA; 1,1-DCE; 1,1-DCA; methylene chloride; TCE; PCE) - Field measurements of pH, specific conductivity, turbidity, and temperature	Monthly for first two years, quarterly thereafter Annually (in lieu of analysis for the indicator compounds), during January or first quarter sampling, as applicable Whenever groundwater samples are collected for water quality analysis
Cross-gradient Groundwater Compliance Monitoring Well Sampling	Grab: Monitoring Well Samples South System (CD-34, CP-S3) West System (CD-45, CD-48) East System (none)	2 6 0 8 per sampling event; or up to about 1000 samples for the 30- year life of the project (Note: West System wells are also down- gradient wells. Therefore, net increase in samples is 2 per event or 240 samples total for project).	- Performance monitoring of South and West Interception Systems - Evaluating Progress of Remedial Action	Groundwater	Same as downgradient monitoring well samples	Quarterly
Groundwater Extraction Well Sampling	Grab: Extraction Well Samples South System West System East System	4 3 3 10 per sampling event; or up to about 1,500 samples over life of the project	- Operational monitoring of South and West Interception systems - Evaluating Progress of remedial action	Groundwater	Same as for monitoring well samples	At Spokane County's discretion, planned frequency is quarterly
Treatment System Assessment (Influent/Effluent Sampling)	24-Hour Composite: Treatment System (air stripping tower) Influent samples	1 per sampling event, or up to 400 total samples for the 30- year life of the project	- Evaluate treatment system efficiency - Evaluate effectiveness of scale control measures - Evaluate mass removal of Constituents of Concern	Groundwater (Influent)	- Constituents of Concern (1,1,1-TCA; 1,1-DCE; 1,1-DCA; methylene chloride; TCE; PCE) - Hardness and alkalinity - Field measurement of pH, specific conductivity, and temperature	At Spokane County's discretion, planned frequency is monthly At Spokane County's discretion, planned frequency is monthly Whenever influent samples are collected for water quality analysis

TABLE E-1
PHASE II SAMPLING AND ANALYSIS PROGRAM
COLBERT LANDFILL REMEDIAL DESIGN/REMEDIAL ACTION^(a)

Project Activity	Sample Type and Location	Total No. of Samples	Purpose of Sampling	Matrix	Analysis	Frequency
	24-hour composite (except as noted): Treatment System (air stripping tower) Effluent Samples	same as for influent samples	<ul style="list-style-type: none"> - Verify effluent meets Evaluation Criteria for volatile organic Constituents of Concern (SOW Table IV-1) - Evaluate treatment system efficiency - Evaluate effectiveness of scale control measures - Meet NPDES discharge monitoring requirements - Evaluate mass removal of Constituents of Concern 	Groundwater (Effluent)	<ul style="list-style-type: none"> - Constituents of Concern (1,1,1-TCA; 1,1-DCE; 1,1-DCA; methylene chloride; TCE; PCE) - NPDES parameters: <ul style="list-style-type: none"> • Phosphorous • Nitrate + nitrite, ammonia, total Kjeldahl nitrogen • Priority Pollutant Metals (total), semivolatile organic compounds, organo chlorine pesticides (including PCBs), organophosphorus pesticides • Electrical Conductivity • Turbidity (grab) - Whole effluent chronic bioassay^(b) - Hardness and alkalinity - Field measurement of pH and temperature - Constituents of Concern (1,1,1-TCA; 1,1-DCE; 1,1-DCA; methylene chloride; TCE; PCE) 	<p>Monthly</p> <p>Monthly during algal growth potential sampling, otherwise quarterly</p> <p>Monthly during algal growth potential sampling, otherwise quarterly</p> <p>Quarterly for first year, annually thereafter</p> <p>Daily</p> <p>Daily for first 60 days, then weekly for first year, then monthly thereafter</p> <p>Within 10 days of startup, within 40 days of startup</p> <p>At Spokane County's discretion, planned frequency is monthly</p> <p>Daily</p> <p>Quarterly</p>
	Grab: Treatment System (influent conveyance pipelines) Influent samples	2 per sampling event; up to 240 samples over 30-year life of project	<ul style="list-style-type: none"> - Evaluate the need for treatment before discharge (per Consent Decree SOW) 	Groundwater (influent) from conveyance pipelines for South and East/West Systems; sample from CP-W1 pipeline not required	<ul style="list-style-type: none"> - Constituents of Concern (1,1,1-TCA; 1,1-DCE; 1,1-DCA; methylene chloride; TCE; PCE) 	Quarterly

TABLE E-1

PHASE II SAMPLING AND ANALYSIS PROGRAM
COLBERT LANDFILL REMEDIAL DESIGN/REMEDIAL ACTION^(a)

Project Activity	Sample Type and Location	Total No. of Samples	Purpose of Sampling	Matrix	Analysis	Frequency
Receiving Water ^(d) Assessment (surface water sampling)	Grab: Little Spokane River, upstream of outfall	Up to 6 samples required sampling period	- Evaluate impact on receiving water - Meet NPDES discharge monitoring requirements	Surface water	- NPDES Parameters • Algal growth potential	Monthly (June - October only)
	Grab: Little Spokane River, edge of mixing zone downstream of outfall	Up to 6 samples over required sampling period	- Evaluate impact on receiving water - Meet NPDES discharge monitoring requirements	Surface water	- NPDES Parameters • Algal growth potential	Monthly (June - October only)

- (a) This table presents only that sampling required by the Consent Decree; Spokane County has the option to conduct additional discretionary groundwater sampling and analysis. NPDES requirements indicated are interim and may change in the future when final requirements are established by Ecology.
- (b) Each chronic whole effluent bioassay sampling event requires collection of three individual samples collected every other day over a 5-day period.
- (c) During 1994 only.

SUMMARY OF ANALYTICAL METHODS

Analyte	Analysis Method
Volatile Organics	EPA 8010A
Organochlorine Pesticides/PCBs	EPA 8081
Organophosphorus Pesticides	EPA 8141
Metals (total)	
Aluminum	EPA 6010
Antimony	EPA 6010
Arsenic	EPA 7060
Arsenic (V)	EPA 7060
Arsenic (III)	EPA 7060
Barium	EPA 6010
Beryllium	EPA 6010
Cadmium	EPA 6010
Calcium	EPA 6010
Chromium (VI)	EPA 7195/6010
Chromium (total)	EPA 6010
Copper	EPA 6010
Iron	EPA 6010
Lead	EPA 7421
Magnesium	EPA 6010
Manganese	EPA 6010
Mercury	EPA 7470
Nickel	EPA 6010
Potassium	EPA 6010
Selenium	EPA 7740
Silicon	EPA 6010
Silver	EPA 6010
Thallium	EPA 7841
Zinc	EPA 6010
Other Inorganics	
Chloride	300.0
Nitrate	300.0
Ammonia	350.3
Total Kjeldahl nitrogen	351
Total Phosphorus	365.3
Other Analyses	
Alkalinity	310.1
Hardness	6010

SUMMARY OF ANALYTICAL METHODS

Analyte	Analysis Method
Biological Analyses	
Algal growth potential (<i>Selenastrum capricornutum</i>)	EPA/600/4-89/001
Chronic whole effluent bioassay [fathead minnow (<i>Pimephales promelas</i>), alga (<i>Selenastrum capricornutum</i>)	EPA/600/4-89/001

TABLE E-3

NUMBER OF WELLS AT EACH PHASE II
GROUNDWATER MONITORING LOCATION

Well Location	Number of Wells
CD-31	1
CD-34	1
CD-36	1
CD-37	1
CD-38	1
CD-41	3
CD-42	3
CD-43	3
CD-44	3
CD-45	3
CD-48	3
CP-S3	1
Total	24

TABLE E-4

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

	Analysis	Sample Container ^(a)	Preservation	Holding ^(b) Time
Groundwater	Volatile Organic Compounds	2 each - 40 mL glass vials (leave no headspace), Teflon-lined septum cap	Maintain on ice	14 days
Influent/ Effluent	Hardness	4-oz plastic	HNO ₃ to pH <2	6 months
	Alkalinity	4-oz plastic	None	14 days
	Semivolatile Organic Compounds	3 each - 1-L amber glass; teflon-lined cap	Cool to 4°C	7 days to extraction; 40 days after extraction
	Organochlorine Pesticides/PCBs	3 each - 1 L amber glass; teflon-lined cap	Cool to 4°C; pH 5-9	7 days to extraction; 40 days after extraction
	Organophorus Pesticides	3 each - 1-L amber glass; teflon-lined cap	Cool to 4°C	7 days to extraction; 40 days after extraction
	Herbicides	3 each - 1-L amber glass	Cool to 4°C	7 days to extraction; 40 days after extraction
	Metals			
	Mercury	1-L polyethylene	HNO ₃ to pH <2	28 days
	Other metals ^(c)	1-L polyethylene	HNO ₃ to pH <2	6 months
	Other Inorganics			
	Chloride, Nitrate, Nitrite	1-L polyethylene	Cool to 4°C	28 days, 48 days, 48 hours
	Ammonia, total Kjeldahl nitrogen, total phosphorus	1-L polyethylene	Cool to 4°C H ₂ SO ₄ to pH <2	28 days

(a) Sample container specifications may be modified after consultation with the analytical laboratory.

(b) Holding times are from date of collection. All samples will be shipped to the laboratory within 24 hours (except as noted for samples collected on Friday). Arrangements will be made with the laboratory for timely receipt of samples with short holding times.

(c) Other metals include antimony, arsenic, beryllium, cadmium, calcium, chromium, copper, iron, lead, manganese, nickel, selenium, silver, thallium, and zinc.

TABLE E-5

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GROUNDWATER MONITORING AND EXTRACTION WELL PURGE VOLUMES

Well	Well Casing I.D. (inch)	Reference Elevation ^(a) (MSL)	Depth to Water ^(b) (ft)	Depth to Bottom ^(c) of Well (ft)	Purge Volume ^(d) (gallons)
CD-31	2.3	1853.63	94	108	9
CD-34	2.3	1858.17	98	110	8
CD-36	2.3	1844.28	90	102	8
CD-37	2.3	1846.40	91	104	8
CD-38	2.3	1847.91	91	109	12
CP-S3	6.1	1845.49	87	99	55
CD-41C1	2.3	1848.64	179	232	34
CD-41C2	2.3	1849.10	180	290	71
CD-41C3	2.3	1849.41	180	402	144
CD-42C1	2.3	1844.00	176	225	32
CD-42C2	2.3	1843.72	176	312	88
CD-42C3	2.3	1843.63	175	400	146
CD-43C1	2.3	1839.98	172	228	36
CD-43C2	2.3	1840.01	172	297	81
CD-43C3	2.3	1840.52	172	400	148
CD-44C1	2.3	1844.84	175	200	16
CD-44C2	2.3	1844.28	175	248	47
CD-44C3	2.3	1844.24	175	295	78
CD-45C1	2.3	1840.75	172	200	18
CD-45C2	2.3	1841.40	172	247	49
CD-45C3	2.3	1841.89	173	339	107

TABLE E-5

GROUNDWATER MONITORING AND EXTRACTION WELL PURGE VOLUMES

Well	Well Casing I.D. (inch)	Reference Elevation ^(a) (MSL)	Depth to Water ^(b) (ft)	Depth to Bottom ^(c) of Well (ft)	Purge Volume ^(d) (gallons)
CD-48C1	2.3	1849.73	178	243	42
CD-48C2	2.3	1850.42	179	302	80
CD-48C3	2.3	1850.08	179	386	134
CP-S1	6.0	1839.59	81	103	97
CP-S4	6.0	1843.52	84	104	88
CP-S5	6.0	1847.48	88	110	97
CP-S6	6.0	1847.68	87	107	88
CP-E1	8.0	1854.20	185	253	532
CP-E2	6.0	1857.70	141	186	198
CP-E3	8.0	1853.29	184	280	750
CP-W1	8.0	1845.02	176	299	962
CP-W2	8.0	1840.36	171	278	836
CP-W3	8.0	1841.72	175	276	790

- (a) Reference points are: 1) for monitoring wells, the top of the PVC access port nipple on PVC casing, and 2) for extraction wells, the top of the water elevation access port nipple on the steel well flange.
- (b) From reference elevation, measured April 1994.
- (c) From reference elevation, based on Phase I and Phase II well logs; extraction well depths adjusted for installation of well vaults.
- (d) Purge volume listed is three times the volume of the water column in the well.

TABLE E-6

APPROXIMATE SAMPLE TAPS LINE VOLUMES

Source	Sample Line Purge Volume ^(a)	Purge Flow Rate During Composite Sampling (mL/min) ^(b)
Influent: Well W1 (North pipeline in process area)	2.5 gallons	350
Influent: Wells W2, W3, E1, E2, E3 (Middle pipeline in process area)	2.5 gallons	350
Influent: Wells S1, S4, S5, S6 (South pipeline in process area)	2.0 gallons	260
Influent: All Wells	1.0 gallons	120
Influent: Bypass	1.5 gallons	200
Effluent	50 mL	N/A

(a) Purge volume is three times volume of sample line.

(b) Purge flow rate is 10 percent of sample line volume per minute.